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ADDRESS OF THE PRESIDENT OF THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS[1]

Two great things have occupied the center of attraction and thought in the affairs of this association and the institutions embraced in its membership during the past year. These are the Smith-Lever Extension Act and the changes in the relations of the agricultural colleges with the United States Department of Agriculture. The discussion of administrative questions involved in the new developments along both of these lines will consume a large share of the time of this convention. It is my purpose at the present hour to consider briefly some of the broader relations of these matters to the future development of the land-grant colleges and the Department of Agriculture.

The Extension Act has rounded out the Federal legislation providing for the endowment along agricultural lines of the institutions whose establishment was made possible by the land-grant act of 1862, not so much by liberal grants of money for extension work as by recognition of such work as a legitimate and necessary function of these colleges which ought to be performed throughout the nation. The chief importance of the new policy of the Department of Agriculture in its relations with these colleges is the recognition that this national institution, founded also in 1862 primarily for research and instruction in agriculture, is really a part of our national system of agricultural education, represented in the states by the land-grant colleges, and that therefore it should work not alongside of them but in close interlocking alliance with them.

The enlargement of the functions of both the colleges and the department due to the

[1] Read at the convention at Washington, D. C., November 11, 1914.

broad and rapid development of extension work is relatively so recent and as yet so incomplete that there has been little realization of its ultimate far-reaching effects. Undoubtedly it is too early for us to see very clearly what these will actually be and uninspired prophecy is always "a shot in the dark." On the other hand when we are laying the lines for a great and permanent enterprise it will not do for us to consider merely past experience and the pressing needs of the present. Whither are we going and what will be the goal of our efforts are reasonable questions and incomplete answers are better than none.

So far extension work in this country has been very largely an incidental function of the agricultural colleges and the department. I do not mean by this that it has been carried on in a small way. Large amounts of information collected by these institutions have been broadly disseminated through the printed page and by itinerant lectures. In recent years demonstration work and the activities of the county agricultural agents have assumed considerable prominence, but have been looked upon as in an experimental stage. In the main the colleges and the department have done extension work with funds under their immediate control and with agents sent out from the central headquarters. Now we have an Act of Congress permanently providing for "cooperative agricultural extension work," to be supported not only with federal and state funds, but also with contributions from counties, local authorities and individuals. The plan of organization already generally adopted involves the appointment of county agricultural agents as one of its leading features. Carried to its logical conclusion this means that the colleges and department will before long have a definite existence as educating agencies in practically every county of the United States. Through organization of the farm men and women into small groups they may ultimately have classes in agriculture and home economics in every school district. This is an educational organization radically different from that followed in the public school system of the United States where local initiative and control have largely obtained, state supervision has been very largely of a general character, and federal supervision has been entirely lacking. The agricultural college is to be changed from an institution having a strictly local habitat with comparatively limited powers for the diffusion of knowledge to a widely diffused institution dealing educationally with multitudes of people at their own homes. And it is to carry with it wherever it goes the national Department of Agriculture not only as a provider of funds but as an active coadjutor in its educational operations. And this education is to be not merely the giving out of information to be absorbed by the students but rather the training involved in active participation in the demonstration and discussion of practical affairs, which will constitute a large share of the extension instruction. Moreover this instruction will deal with matters which are of vital and immediate importance to the students since they will affect their incomes, daily practises, and community interests.

The character of the atmosphere and work of every educational institution is powerfully affected by the character and aims of its students. There is therefore no doubt that the reaction of the great masses of extension students on the agricultural colleges and the department will be a very important factor in their future development. This will manifest itself in various ways. The real problems of the farming people, for example, will be brought out much more definitely and clearly than heretofore and these will be pressed home upon the research workers in the stations and the department. The young people brought up in communities where the extension service has been well organized and effective will be much better prepared to enter the agricultural schools and colleges, but they will also not be satisfied with much of the instruction as now given in our agricutural colleges. The attitude of the farming people toward the colleges and the department will be broader and more sympathetic but it will also be more intelligently critical.

The results of the investigations of the de-

partment and the experiment stations, as well as the teachings of the agricultural colleges, will hereafter be put to a much more thorough practical test. When the county agent system is well established in any region it will naturally be expected that after a reasonable lapse of time the agriculture of that region will show definite improvement. Not only should there be better crops and animals but they should be so handled and marketed that the farmers will receive more satisfactory returns for their labor. Moreover the affairs of the farm homes and of the rural community should be more efficiently managed. It will no longer answer to state the agricultural progress of this region in general terms, however glittering. There must be definite facts and figures to prove every statement. And these should emanate not from the institutions and their agents who have been working there, but from the people for whose benefit the work has been done. It may be that the county agent will be directly responsible for the condition of affairs in his own county but everybody will know that he has had the backing of the agricultural college and the Department of Agriculture. These institutions will be held chiefly responsible for the success of their agents. No other educational system has had such severe tests of its practical value. Here are standards of judgment from which there can be no appeal. If this system was to be applied only here and there, failure might be attributed to some peculiar local conditions. But this is to be a national system whose failure, if there is failure, will be due to imperfect or false teachings and wrong methods of administration.

This new system, then, is not merely an important addition to the business of the agricultural colleges and Department of Agriculture for which they must make proper arrangements by appointing competent agents and securing the economical expenditure of public funds. It is of course to be expected that these institutions will put aside all political or other improper motives in the organization and work of the extension force. To gather about them and to send into the field a body of the most experienced and best trained men and women in thorough sympathy with the men, women and children on our farms, that existing conditions will permit, will indeed be a great achievement. To operate this force harmoniously and successfully under a cooperative system which involves the close alliance of national, state, county and local organizations, will be a most wonderful thing. But we may have the most competent extension force we can get throughout the nation and the most cordial relations among the cooperating agencies and yet our extension system may prove a comparative failure. And it will be this unless the colleges and the department look upon the extension work as a vital part of their organism, even as the feet and hands are parts of our human bodies. The blood that flows in this body must be rich and pure, the nervous force that propels it must be strong and active, the will that controls it and the spirit which emanates from it must be infused with the highest ideals of public service. Not only the administrative officers of the colleges and the department must work for the best development of the extension system as an organic part of their institutions, but the investigators and the teachers must feel and act toward the extension workers in the most sympathetic and helpful spirit. And on the other hand, the extension workers, whatever the distance that separates them from headquarters, must fully realize that they are essential parts of the institutions they locally represent and must be thoroughly imbued with a spirit of loyalty to these institutions and an attitude of broad and intelligent appreciation of the functions of administrators, teachers and investigators at the colleges and the department. There must be no carping criticism of the theoretical *vs.* the practical as if these are inevitably to be set one over against the other, but a generous recognition that in order to do our best work for the advancement of agriculture and home economics, we must know both the real facts as determined by observation and experience and also the principles on which these facts

are based as determined by reason and investigation.

The man in the field must constantly bear in mind that he owes what he has to demonstrate very largely to the patient labors of the investigator and the clear and orderly exposition of the teacher. And the man in the laboratory or the classroom must do his work with the consciousness that what he discovers or teaches will speedily and broadly be put to the test of actual trial in the field.

Some have feared that the wide expansion of the extension work with its accompanying great popularity would break down the thoroughness of investigation and the solidity of teaching in our agricultural institutions. Without doubt there is grave danger of evil effects of this character due to the very rapid enlargement of the extension service. As long as the supply of properly trained men is far below the demand that branch of the service where the demand is most urgent is likely to profit at the expense of the other branches. A great popular movement like the present insistence on the wide dissemination of agricultural knowledge is likely to have a torrential influence and sweep many men off their feet and even institutions off their foundations. But such floods are short-lived. After they subside it is often possible to accomplish greater things than were feasible before they came.

For a time we may expect that our agricultural institutions will be so busy establishing the extension system on a grand scale that they may seem to be, and in some cases may actually be, neglectful of the best interests of their research and teaching divisions. And the public will hear and think comparatively little of any of their work except the extension service. But no sooner will the extension service be well established than it will be apparent that it can not do what its enthusiastic propagandists have led the unthinking multitude to believe it would straightway accomplish. Here and there will be great and striking results due to peculiar conditions. There may even be some steady progress in agricultural betterment over wide areas. But in the main important immediate changes in agricultural practise will be relatively few and general advancement will be slow. The reasons for this will be many and complicated. But two important things affecting our agricultural institutions will be apparent.

First it will be clear that to many of the agricultural problems which the extension men will encounter in their work among the farmers, no solution or at best a very imperfect solution is now available. The limitations of our knowledge will be more and more apparent as this knowledge is widely put to the test. The need of further investigation along many lines will therefore become clearer and the demand for it will be much more widespread and insistent.

Secondly, it will not be long after the extension force is expanded to the extent permitted by available funds before the defects in the training of the field men and women will be clearly revealed. A goodly number of those who will enter with great enthusiasm on this service will shortly be actually "prophets without honor in their own country," not so much because the people are blind to their interests as because these prophets have not foretold the things that should come to pass. In some cases this will be because the extension agents have not properly improved existing opportunities for training and have gone on presumptuously without regard to their ignorance. But in most cases these agents will be deeply conscious of their own lack of knowledge and regretful that they have not been better prepared for this special service. And even those who have had the best training and experience and are most successful in their work will have a keen sense of their limitations and will realize the defects of their training. We may therefore expect a demand for better teaching at our agricultural colleges from two sources, (1) from the people for whose benefit the extension service is established and (2) from the workers in that service.

The development of the extension service will therefore put an additional responsibility and burden on the teaching force of our col-

leges. This is already overburdened by the rapid increase in the number of students. Under existing conditions this increase will grow larger at an accelerating rate, for the people are just beginning to realize the value of an agricultural education. It is very important that the colleges should seriously consider the situation confronting their teaching departments with a view to adjusting them to the new demands. For it is clear that the agricultural colleges must soon reach a decision as to what grades of teaching they will undertake and what they will leave to other agencies to perform. It is clearly their duty to provide thorough and ample courses of study for those who are to become investigators, teachers in secondary and collegiate institutions, extension workers, federal and state officials, managers of large enterprises directly or indirectly connected with agriculture, and those farmers who are desirous of thorough college training as a preparation for following the art of agriculture.

On the higher and more technical side of agricultural education greater attention is urgently needed to develop strong collegiate courses with ample specialization for various purposes and graduate instruction of the best type. On the other hand the flood of short courses which has so rapidly increased in amount and variety in recent years must be stemmed and plans must be definitely made for diverting this into channels outside the college. No doubt these courses have served a very useful purpose but the situation with regard to them is wholly different from what it was at their inception or even a few years back. Agricultural education is now a great universal demand and will be much more generally sought when the extension system is well under way. Much more must be done, and done as quickly as possible, to provide schools in the local communities which can take care of the great mass of students who desire only elementary and fragmentary instruction in agriculture. Well-trained and experienced teachers, capable of giving thorough collegiate and graduate instruction, are not so numerous that we can afford to use up their time and energy in giving superficial instruction to great classes of a hundred or more miscellaneous students at short winter courses or in summer schools. Where are we to get the great agricultural scholars who are to lead and inspire our college students if we do not give such men the time and opportunity to keep up-to-date in their specialties, to read, think, investigate and travel as college professors ought to? One broad effect of the new developments in the general college organization should therefore be a clearer differentiation of the collegiate teaching body and a systematic arrangement under which the problems of strictly collegiate and graduate teaching shall receive the attention which they deserve. Obviously many things are now being done in the regular college courses in agriculture which should be turned over to the secondary schools and other things which should be relegated to the extension divisions. There is plenty of opportunity for a better pedagogical standard, better laboratory and field exercises and equipment, more satisfactory text-books, manuals and illustrative material for work in the higher ranges of agricultural instruction.

Not only is there need for more attention to the perfecting of the collegiate courses of instruction for the general body of agricultural students, but special attention should be given to courses for the training of teachers for the regular work of the colleges, for extension work, and for secondary schools. As regards extension work this need is now very urgent. The demand for secondary teachers of agriculture is also growing apace. The constantly broadening interest in vocational education is sure to bring a far greater demand on the land-grant colleges for the training of teachers, not only in agriculture, but also in the trades and home economics. The National Commission on Vocational Education made the following reference to this subject in its recent report to Congress. H. R. Doc. 1004, 63d Congress, 2d session, p. 43.

> We can not rightly undertake a program of practical education in this country and carry it through successfully without teachers properly

qualified by training and experience for their work and with practically no facilities for their proper training in the future.

Here and there are schools which have rendered good service by equipping instructors in manual training, but it is safe to say that at the present time not a half dozen schools exist in the United States which afford an adequate opportunity to secure thoroughgoing preparation for the teaching of trade and industrial subjects. Excellent as has been the technical preparation which the state colleges of agriculture and mechanic arts have given to their students, many of them have not as yet developed departments of education adequate to the task of training prospective teachers either of agriculture or the mechanic arts in the administrative and teaching problems of the vocational school. The comparatively poor support given to this feature of their work by some of the agricultural and mechanical colleges is shown by the fact than out of an appropriation of more than $2,600,000 made to them by Congress under the Match and Nelson Acts for the year 1912–13, these colleges spent less than $34,000 "for the preparation of teachers in the elements of agriculture and mechanic arts."

In their teaching departments the agricultural colleges do not need any longer to bid for great numbers of students. The problem rather is to determine more definitely than hitherto what classes of students the colleges should undertake to train and then to use their available funds in providing the most efficient courses of instruction to meet the requirements of such students. The colleges can now greatly aid in the proper development of the general system of education in agriculture and other vocational subjects, which sooner or later will permeate our public school system, by assuming more strongly a policy of exclusion as regards students not qualified to profit by college instruction. Much needs to be done to correct a widespread popular notion that these colleges ought to do all that is necessary for the state to do as regards the teaching of agriculture and other vocational subjects. Unless the colleges themselves cut out these features of their present work which are really outside their province and devote themselves more strongly to those things, such as the preparation of investigators, teachers and extension workers, which should permanently constitute their chief functions, they will subject themselves to increasing criticism from the more intelligent body of their constituents. They will also surrender some of the highest privileges of leadership in the great educational movement now in progress in this country.

This association has been greatly interested in the promotion of graduate study in agriculture and has practically shown this interest by the maintenance of the biennial short-term graduate school of agriculture, the last session of which was successfully held at the college of agriculture of the University of Missouri. Some of our colleges have made a good beginning of regular graduate courses. Others are not yet in a position to undertake such courses in a satisfactory way. May it not be the duty of this association to take up this matter more thoroughly and through its standing committee on graduate study extend the cooperative efforts of the colleges to provide graduate courses for all students through the country who are qualified to pursue them? There certainly should be soon a number of centers of graduate study in agriculture in the United States which will be broader in scope and more thorough in equipment and teaching than any the world has yet seen. Travel and study abroad will always be beneficial to a certain extent for persons aiming to become experts but the United States should have graduate schools of agriculture which will not only be thoroughly satisfactory to her own students, but also highly attractive to those of other countries. We can not be content as long as any considerable number of our agricultural investigators and college teachers have had only an undergraduate course. Under existing circumstances these men should be encouraged in every possible way to extend their studies after they enter the employ of our agricultural institutions. But stronger efforts should also be made to encourage the taking of graduate courses before entrance on active professional careers. And the bars of entrance to research or teaching positions in our colleges and the department

should be steadily raised until our agricultural institutions in this respect are on a par with first-class higher institutions of learning and research in this and other countries.

The events of the past year are also destined to have far-reaching effects on the work of our institutions devoted to agricultural research. The great expansion of extension activities will inevitably lead to much more varied demands for research. The more the extension workers and to a considerable extent the agricultural people with whom they work, come to realize that our present knowledge will only go a little way toward solving the multitudinous problems of agriculture the more widespread and insistent will be the demand for more numerous and thorough investigations of these problems. It is therefore very important that we should consider the actual status of our research institutions and, while rejoicing in their many good features and their valuable work, should be active in remedying their deficiencies and enlarging their services.

So far our agricultural experiment stations and Department of Agriculture have been hampered in their research work because of the varied duties imposed on them outside of their research functions and the lack of proper differentiation of lines of work and personnel. The department is now alive to this deficiency and under the plans for reorganization undertaken by Secretary Houston aims to make a distinct separation between research, extension and regulatory activities. It will thus be possible to know what funds, equipment and force the department actually has for research, to determine definitely what problems it will attempt to solve, and to put a more rigid responsibility on its research workers to formulate good plans and to hold to their work on the chosen projects until something worth while is accomplished. If adequate supervision of the research work of the department is provided this plan should result in better and more productive research.

The closer relations of the agricultural experiment stations with the department under the new arrangement for comparison of projects and for publication of results in the *Journal of Agricultural Research* should also be a great stimulus to both the state and national institutions to improve the character of their research undertakings.

Meanwhile a private organization with large resources is planning to undertake agricultural research on a scale commensurate with that on which research in other lines has been successfully prosecuted by similar agencies. The friendly rivalry of a great private institution in this field ought to prove very beneficial to our public agricultural institutions.

In a general way our agricultural research is at present too diffuse. We have too large a number of projects for the funds devoted to them. If this private institution follows the course pursued by similar institutions in other fields and concentrates its efforts on a few large undertakings it may serve to aid our public institutions to change their policy in this direction. We have been so desirous of meeting the numerous demands for experimental inquiry and so ambitious to cover the whole field of agriculture that we have so far permitted the undertaking of too many small investigations and very generally with unsatisfactory results.

Recently a public discussion has arisen on the question whether it is better to have research institutions separately organized or connected with colleges or universities. From the standpoint of agricultural research this discussion is timely. At the dedication of the Marine Biological Laboratory at Woods Hole, Mass., President Woodward of the Carnegie Institution pointed out some of the weak points in the present attitude of educational institutions toward research.[2]

> . . . It is often assumed that research is a harmless and a fruitless diversion in the business of education, and that it requires but a portion of the leisure time of those chiefly occupied with duties of instruction and administration in colleges and universities. On the other hand, some eminent minds maintain that serious and fruitful research can be advantageously pursued only in connection with work of instruction, while a few

[2] SCIENCE, August 14, 1914.

enthusiasts go so far as to suggest that the mental and bodily vigor of an investigator can be conserved only in the stimulating presence of immature minds, otherwise known as students or candidates for higher academic degrees. Such eminent minds and enthusiasts entertain grave doubts as to the propriety of the existence independently of colleges and universities of research establishments. It is darkly hinted, indeed, that the latter may work harm, if not ruin, to the former by enticing the effective teacher away from his students and by checking the diffusion in order to promote the advancement of knowledge. . . .

. . . While it is quite true that a majority of the fundamental researches of the past have been accomplished by individuals and that they will continue to be so accomplished in the future, it should nevertheless be the primary purpose of a research institution to institute and to conduct research; to take up especially those larger problems not likely to be solved under other auspices, problems requiring a degree of organized effort and a continuity of purpose surpassing in general the scope and the span of life of any individual investigator. . . .

. . . They should recognize that the ends of research are not limited to the highly worthy object of fitting candidates for the doctorate degree; and they should recognize that there is the amplest room for the simultaneous existence of educational institutions along with other organizations whose primary purpose is not the diffusion but the enlargement of learning. . . .

. . . Research and research organizations are somewhat in danger of being swamped by an excess of symbiosis. . . . Instead of following precedent, we should in general avoid it. When, for example, a research fund is established we should not make haste in academic fashion to set up poor-boy scholarships and reviving fellowships to be awarded to the amateur and to the tyro, but we should seek to originate and to conduct research under the auspices of competent and responsible investigators. And as regards research in academic circles, we need to fix attention rather on the professors who are qualified to extend the boundaries of knowledge than on their pupils. These latter, if worthy of the name, will require little formal instruction in the presence of evolving discoveries and advances; moreover, they must learn early to think with their own hands if they may hope to become either competent teachers or leaders in work of research.

Dr. Woodward's suggestions are further elaborated by Professor W. E. Castle of Harvard University in Science, September 25, 1914.

. . . Our larger universities, and many of our smaller ones too, point with pride to the research work which they are accomplishing. But in not a few cases this work, if inspected carefully, is found to take final shape in dissertations for the doctorate, of doubtful value as contributors to knowledge, prepared primarily not because the author had something of value to record but because he had to record something in order to get the coveted degree.

The chief energies of many professors entirely competent as investigators are wholly absorbed in laboriously dragging candidates through the academic mill up to the final examination for the doctorate. Their success as research professors and the standing of their universities as centers of research is commonly estimated in numbers of doctorates conferred. . . .

The attempt to combine teaching with research has another indirect but evil consequence. The periods which the professor can himself devote to research are intermittent and fragmentary. This affects disadvantageously the topics selected for investigation. They too must be minor and fragmentary. Great fundamental questions requiring long continued and uninterrupted investigation can not be attacked with any hope of success by one who has only an occasional day or a summer vacation to devote to research. The necessity too, of hunting up thesis subjects for students, small enough in scope to be handled successfully by a beginner in a limited time and yet novel enough to make a showing of originality reacts unfavorably on the professor's own work. It loses both in breadth and depth. He who in the full maturity of his powers should be doing a day's work, runs errands for boys, holds their coats and carries water. Imagine what the "Origin of Species" would have been like had it been brought forward vicariously as a series of theses for the doctor's degree, each aiming to present a different point of view or a novel method of attacking evolutionary problems. . . .

The university is an entirely suitable place, in many respects the *best* place, for a research establishment; but when such establishments are founded in connection with a university, their purpose *for research* should be made very clear and their administration should be kept very distinct

from both teaching and the demonstration of discoveries to the public.

Undoubtedly both the state agricultural colleges and the Department of Agriculture are having serious difficulties in creating within themselves the proper attitude and atmosphere with respect to research. The colleges are troubled with the well-nigh overwhelming inrush of students and the innumerable calls for service in the extension fields. The department is in difficulty because of the constantly increasing pressure of its inspection work and other administrative duties and the fact that it is supported wholly by annual appropriations, money for research being considered as largely an incidental matter in the general budget. Research in both national and state institutions is also hampered by the insistent calls for immediate practical results, by the shifting of men from one institution to another without regard to the requirements of their research work, and by allurements of popular applause for striking advertisements of alleged accomplishments. The atmosphere of our agricultural institutions is surcharged with a feverish excitement. Men are hurrying about to do this or that which is supposed to be absolutely necessary to keep their students or the legislators or the farmers contented and sympathetic. Even on the scientific side there is much of distraction. New organizations are constantly being formed, new journals are being established and edited, local, state, national and international meetings are being held. Besides all these things, some agricultural scientists think it is necessary for them to engage in practical agriculture and actually manage farms or other commercial enterprises. Administrative, educational and commercial factors make up so much of the atmosphere of our agricultural institutions that those gentle and highly intellectual influences which are needed to inspire real research are apt to be felt but weakly in the body corporate. The *great* problem, then, is how to make such influences so highly intensive that they will be felt above all the others. For only in this way can we hope to make the research work of our public agricultural institutions so efficient that its results will be an adequate foundation for the administrative and educational functions of these institutions and for the permanent prosperity of our vast agricultural business.

Research is not merely an incidental function of our agricultural colleges. It is under the law a necessary part of their business, and they have large amounts of public money which can be lawfully spent only for this purpose. But beyond this it is fundamental and essential to their success in teaching and extension work. They are therefore under the greatest obligations to create within themselves the atmosphere and conditions most favorable to successful research and to make sure that their research workers can give undivided attention to their investigations.

Words of friendly criticism may be as silver but far better are golden words of encouragement. And there are many of these which might be fitly spoken on an occasion like this. It will be thirty years next July since a little band of educators, scientists and public officials met in Washington at the call of the Commissioner of Agriculture to discuss the needs of the department and colleges of agriculture and their mutual relations. This proved to be the beginning of this association.

Agriculture in the United States was then a depressed and neglected industry; agricultural investigators, teachers and students were very few, and the Department of Agriculture was chiefly known as a seed-distributing agency. Behold how much has been accomplished in three decades, less than a single generation. A great system of agricultural research has been developed within the department and the states and this is found in organized form in every state and all our outlying territories. So much definite agricultural knowledge has been accumulated that strong and broad agricultural courses have been established in the colleges with the result that they are thronged with agricultural students. The practical outcome of the investigations of the department and the stations and the teachings of the college has been so far beneficial to our agriculture that agricultural education is no longer

confined to our colleges but is now pursued by thousands of students in special and ordinary secondary and elementary schools. And this movement is rapidly growing. Our adult farmers are so desirous of securing the information which our agricultural institutions have to give that many millions of copies of department and college and station publications are annually distributed, the farmer's institutes last year had an attendance of over 3,000,000, and a comprehensive system of agricultural extension service is rapidly covering the whole United States. And now has come this new union of the national and state and local forces for the dissemination throughout our vast territory in a practical way of whatever knowledge our research and educational agencies have accumulated or will gather in the future. And this comes at a time when all classes of our people, in both city and country, are alive as never before to the fundamental importance of our agricultural industries and the absolute necessity of having contentment and permanency in our rural communities.

All will acknowledge that the national and state institutions represented in this association have individually and collectively rendered service of great value to the republic in the past thirty years. But who will venture to set the limits of their achievements in the next thirty years? Certainly the program which they have set for themselves should be a great inspiration to all who serve in their ranks. They have defined agricultural research and education in terms broad enough to take in the multitudinous variety of production in agricultural regions which stretch from the arctic circle to near the equator, as well as a wide range of economic and social problems connected with the business of farming, the life of the farm home and the activities of the rural communities. The extent and variety of the subject-matter to be studied and taught would in themselves be powerful incitements to strenuous intellectual endeavors. When to these are added the vast extent of our territory and the tremendous number of our people the human interests involved make a powerful appeal to our emotions. And finally the complicated administrative machinery which we are developing for this agricultural service, in harmony with the American interlocking system of national, state and local jurisdictions, will require the exercise on a grand scale of combined energy and self-restraint which are the most marked characteristics of the will power of the modern civilized man. If what we call cooperation, fraternalism, or any other name designating united, harmonious and effective activity of groups of people, is to be the governing principle of community, national and international life in the years to come, it may have the finest exemplification in the activities of the institutions represented in this association. And this as I understand it is the example which we are proposing to show to the world. The very difficulties of the scheme are alluring to us and the more we imbibe the spirit of this undertaking the more we are convinced that we can make it a success.

A. C. True

INTERGLACIAL MAN FROM EHRINGSDORF NEAR WEIMAR

The attention of prehistoric archeologists has long been turned toward the region of Weimar, Germany, because of important discoveries made at Taubach and Ehringsdorf, both in the Ilm Valley. Known since 1871, the station of Taubach (back of the village of that name) was systematically explored between 1876 and 1880. The deposits at Taubach and Ehringsdorf are alike. Their basis is a layer of sand and gravel dating from the third or Riss glacial epoch (Obermaier). Above this is lower travertine with remains of the mammoth and woolly rhinoceros near the bottom, and those of *Elephas antiquus* and *Rhinoceros merckii,* both witnesses of a warm climate, near the top. Next above at Ehringsdorf comes the so-called "Pariser" (corruption from Poröser) deposit, a sort of loess. Higher still is a deposit of upper travertine with remains of the stag and woolly rhinoceros; curiously enough the *Rhinoceros merckii* also occurs at this level.

The human remains in question, consisting of a nearly complete human lower jaw, form the subject of a paper just published by Professor G. Schwalbe[1] of Strassburg. Professor Hans Virchow was to have given a demonstration of the specimen before the German Congress of Anthropology at Hildesheim last August, but the congress was not held on account of the war. The discovery was first brought to my attention through a letter from Dr. L. Pfeiffer, of Weimar, under date of July 20, 1914. Like much of the archeological material previously found at Taubach and Ehringsdorf this lower jaw is now the property of the museum at Weimar. Because of its double association with that city, Schwalbe proposes to call it the Weimar lower jaw.

The lower jaw was found on May 8, 1914, at a depth of 11.9 m. below the surface in the lower travertine, 2.9 m. below the so-called Pariser loess. It is from the Kämpfe quarry at Ehringsdorf and was brought to light by means of a blast. Under the circumstances it was fortunate indeed that the lower jaw suffered no worse. All the teeth are intact and in situ save the two right incisors (in their place is a small mass of travertine containing a univalve shell). Both halves of the body are practically complete. The right ascending ramus is in part present; although not enough remains to save the mandibular angle, the coronoid and condyloid processes, and the mandibular or sigmoid notch. The left ascending ramus is completely gone.

A number of remarkable features are combined in the Weimar lower jaw. The absence of a chin is doubly emphasized because of the pronounced alveolar prognathism as shown in the figures, a condition not found in the lower jaws of Krapina and La Chapelle-aux-Saints, nor even in that of *Homo heidelbergensis*. Closely related to the alveolar prognathism is the sloping nature of the inner surface of the jaw in the region of the symphysis, region called by Schwalbe planum alveolare. In all other lower jaws of the Neandertal type a median line in this field is much more nearly vertical. Below this planum alveolare is a spinous area but no distinct spines for the attachment of the genioglossal and geniohyoid muscles. Neither is there the customary ridge on the inner surface of each corpus for the attachment of the mylohyoid muscles. The absence of this mylohyoid ridge is even more marked than in the well-known mandibles of the Neandertal type.

The foramen mentale is unusually large. It is directly beneath the first molar (similar to the situation in *Homo primigenius*); while in recent man this foramen is located farther forward beneath the second premolar. In the Heidelberg lower jaw it is also large but situated further forward than in the specimen from Weimar.

Schwalbe lays special stress on the narrowness of the arch of the Weimar jaw. The breadth between the inner faces of the third molars is 48 mm.; the distance from posterior surface of the third molar to the anterior margin of the median incisor is 69 mm. The index derived from these two measures in the chimpanzee is 54.6. In the Weimar jaw this index is 69.5; while it is much larger in other known fossil human lower jaws: Heidelberg 75.7, Krapina 80 and La Chapelle 100. Schwalbe admits however that the low index of the Weimar jaw might be due in part at least to post-mortem deformation.

The teeth are much worn. Since the premolars are less worn than the canines, one is led to conclude that the points of the canines stood above the level of the premolars. There is no diastema between the canines and the first premolars. A notable feature is the relative smallness of the third molars. This unexpected condition proves that the tendency of the third molars to disappear is of much more ancient origin than other known jaws of the Neandertal and earlier types have led us to suppose.

Without hesitation Schwalbe places the Weimar lower jaw in the Neandertal group, for which group he proposed some years ago the name *Homo primigenius*. In the preliminary paper he does not describe the cul-

[1] "Über einen bei Ehringsdorf in der Nähe von Weimar gefundenen Unterkiefer des *Homo primigenius*," *Anat. Anzeiger*, Band 47, 337–345, 1914.

tural remains found at the same level. He does however mention some of the numerous accompanying fauna: *Rhinoceros merckii,* stag, horse, ox and cave bear. There was also an abundance of charcoal and flint implements, the latter for the most part apparently retouched points and scrapers.

Two human teeth (one of a child and one of an adult) had already been found in the lower travertine of Taubach. During the summer of 1908, Dr. Pfeiffer found human skull fragments in the same deposit at Ehringsdorf.

Both Obermaier and Schmidt consider the lower travertine of Ehringsdorf (the deposit in which the lower jaw was recently found) and Taubach to be older than Mousterian. Although it contains no typical coups de poings, on account of the character of the fauna as well as the industry, Obermaier would call the deposit of Chellean age. For Schmidt, who has recently published examples of the industry, it is Acheulian.

In any case all are evidently agreed that the deposit belongs to the Riss-Würm interglacial epoch. In that case according to one school it might be Chellean, Acheulian, or early Mousterian; according to the school of Penck, it would have to be later Mousterian, since he places early Mousterian during the Riss glacial epoch and the Chellean-Acheulian during the second or Mindel-Riss interglacial epoch.

Whichever view is correct, on account of its anatomical characters, as well as the position of the deposit and the nature of the associated cultural and faunal remains, the anthropologist may justly claim for the Weimar lower jaw an antiquity surpassed perhaps only by the skull of Piltdown and the Mauer (*Homo heidelbergensis*) lower jaw.

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THE CHICAGO MEETING OF THE NATIONAL ACADEMY OF SCIENCES

The National Academy of Sciences will meet December 7, 8 and 9 at the University of Chicago. Social headquarters will be at the Quadrangle Club, 58th Street and University Avenue, where the members will meet for the first time December 7, 1:00 P.M., for luncheon. A feature of the meeting will be the second course of William Ellery Hale lectures on evolution, two lectures by Professor William Wallace Campbell, director of the Lick Observatory, on Stellar Evolution and the Formation of the Earth. These lectures and four sessions with papers by members of the academy and others will be open to the public.

The council will meet at 4:30 P.M., December 7, at the Quadrangle Club.

A preliminary program of the scientific papers is as follows:

I. *Mathematics*

Gilbert Ames Bliss: *A Generalization of a Theorem of Gauss Concerning Geodesic Triangles.*

If a line OA of unit length is parallel to the normal at a point a of a surface S, then A may be regarded as the image of a on the unit sphere with center at O. It is a theorem due to Gauss that the difference between π and the sum of the angles of a geodesic triangle on the surface is numerically equal to the area of the image of the triangle when each point is mapped on the sphere as above described. The paper is concerned with a generalization of this theorem. The magnitudes involved in the statement of the theorem, angles, the equations of the geodesic lines, the area of the image of the triangle, are expressible in terms of invariants associated with the integral of length on the surface S. For a more general integral of the calculus of variations some of the analogous invariants have been found by the author and other writers. In the present paper the remaining invariants are described, and a theorem corresponding to that of Gauss is deduced.

Leonard E. Dickson: *Recent Progress in the Theories of Modular and Formal Invariants.*

Contrast between algebraic and modular invariants. Formal invariants and their construction. Modular plane curves for modulus 2.

G. A. Miller: *The ϕ-subgroup of a Group of finite order.*

In 1885 Frattini introduced the ϕ-subgroup of a finite group G as the characteristic subgroup whose individual operators enter into no set of

independent generators of G. In the present investigation the ϕ-subgroups of various important groups G are studied,—in particular, of groups of order the power of a prime, of direct product groups, of abelian groups, of the Sylow subgroups of the symmetric group on n letters. Two of the principal results are: (1) The ϕ-subgroup of a Sylow subgroup G of the symmetric group on n letters is the commutator subgroup of this Sylow subgroup G. (2) The various sets of independent generators of a group G of order the power of a prime contain the same number of generators, so that this number is an invariant of the group G.

ELIAKIM H. MOORE: *On the Integration by Successive Approximations of the Ordinary Differential Equation of the First Order in General Analysis.*

The classic problem of integration of a simultaneous system of n ordinary differential equations of the first order may be expressed as follows: To determine the n-partite number or point $\xi=(x_1, \cdots, x_n)$ in n-space S_n as a function of the real variable t in such a way as to satisfy the differential equation

$$\frac{d\xi}{dt} = K(t, \xi)$$

with the initial condition:

$$\xi(t_0) = a = (a_1, \cdots, a_n).$$

Here for every t of a certain interval T' of the real number system T and point ξ of a certain region S' of S_n. $K(t, \xi)$ denotes a point of S_n; t_0 lies within T'; a lies within S'; and K satisfies the continuity and Lipschitz conditions. A point ξ may be thought of as a function of i; $\xi(i) = x_i$ $(i=1, \cdots, n)$. If in this problem we replace systematically the special variable i with the special range $i=1, \cdots, n$ by a general variable p with the general range P we obtain the corresponding problem in general analysis. Then by imposing suitable conditions on S', K and a we validate for the general equation with initial condition the process of integration by successive approximations. The general treatment covers the classical case and, for example, certain types of infinite simultaneous systems of differential and of integro-differential equations.

F. R. MOULTON: *An Extension of the Process of Successive Approximations for the Solution of Differential Equations.*

With the exception of the Cauchy polygon process, which is not of practical value, the existing methods of solving differential equations have, in general, only a limited domain of applicability. The processes defined in this paper apply to a very general class of differential equations, they are convenient in practise, and they furnish the solution with any prescribed accuracy in an arbitrary part of the domain of its existence. The range on the independent variable for which the solution exists is not known in advance, but the process enables one to determine when he is safely within that range.

H. S. WHITE: *The Synthesis of Triad Systems Δ_t in t Elements, in Particular for $t=31$.*

This note reviews earlier and recent studies in triad systems, and signalizes one advance step. The field is largely unexplored, and progress requires study of specimens and induction. Twenty-three specimens of Δ_{15}'s showing odd and even structure, many new, are available in Miss Cummings's dissertation (Bryn Mawr, 1914); and one of different structure, headless. Upon these one new theorem is verified, then demonstrated, relating t with $2t+1$. This makes possible the precise enumeration of Δ_{31}'s of odd and even structure which can be compounded from a headless Δ_{15} and any other. Headless systems (yet unpublished) prove the resulting Δ_{31}'s to number above 14!

E. J. WILCZYNSKI: *Conjugate Systems of Space Curves with Equal Laplace-Darboux Invariants.*

It is well known that four linearly independent solutions of a linear differential equation of the form

$$\frac{\partial^2\theta}{\partial u\,\partial v} + a\frac{\partial\theta}{\partial u} + b\frac{\partial\theta}{\partial v} + c\theta = 0$$

determine a surface upon which the parametric curves form a conjugate system. A great deal of work has been done upon the special case when the Laplace-Darboux invariants of the equation are equal to each other. The geometrical significance of this condition, which up to the present time seems to have escaped notice, is the object of Mr. Wilczynski's communication.

II. *Astronomy*

E. E. BARNARD: *Explanation of Certain Phenomena of the Tail of Comet Morehouse* (III., 1908).

Within certain limitations, there is nothing so wonderfully effective for the study of cometary phenomena as the stereoscope. The author has applied this method for the study and explanation of the remarkable phenomena of the tail of

Morehouse's comet on October 15, 1908. A good series of photographs of the comet was obtained on that date in this country and in Europe, the earliest of these being made at Geneva, Switzerland. The photographs made at the Yerkes Observatory (continuously) on that date with the Bruce telescope extended from $6^h\ 18^m$ to $13^h\ 28^m$ C. S. T., or for a period of $7^h\ 10^m$. A set made in France, another in England, and two sets obtained by the author with the Bruce telescope of the Yerkes Observatory, are available for stereoscopic combination. It is from the study of these combinations that the following simple explanation of the phenomena is derived.

The photographs all show a twisted appearance of the tail about ½° from the head, apparently joined to the head by a slender straight beam. The broken part of the tail became more disrupted, and changed more rapidly in the later photographs, until it formed a broad mass with a broad tail. A study of the stereoscopic views shows what really happened. At a time earlier than the first photograph the comet had discarded its tail (by ceasing abruptly to emit matter in that direction) which drifted away into space. For some reason, perhaps from a disturbance due to the cessation of emission at that point in the comet's head, the rear end of the receding tail "buckled" and became twisted into a spiral which finally formed an irregular ring—very much like the smoke ring familiar to the users of tobacco. Every part of this condensation ring sent out a continuous stream of matter until it formed, roughly, a long open cylindrical tail to the ring, with one end pointed more or less towards us.

This last phase of the disturbance was the condition of the tail at the time of my last photographs of that night. By the next day the remnant of the discarded tail had drifted farther away and had become so changed as to be of little interest in connection with its form on October 15. The slender beam of light that apparently connected this phenomenon with the head was really a new tail which was forming and which did not touch the masses in the old tail but passed behind them, at a considerable angle as shown by the stereoscope.

W. W. Campbell: *On the Radial Velocities of Nebulæ.*

The radial velocities of 54 planetary and ring nebulæ and nebulæ of irregular form, have been determined at the Lick Observatory and at the D. O. Mills Observatory in the past three years by spectrographic means. The nebulæ are remarkable for their high velocities. Only a fifth of the radial velocities are less than 10 km. per second, there are 9 radial velocities greater than 60 km. per second, and the average for the 54 nebulæ is 42 km. per second. This is 7 times the average radial velocity of the so-called helium stars, which have generally been supposed to be the stars most recently evolved from nebulæ. Omitting 12 extended and ring nebulæ, the average radial velocity of 42 planetary nebulæ is 46 km. per second. Two nebulæ, close together in the sky, have been observed as 202 km. per second recession and 141 km. per second approach, respectively,—a relative radial motion of 343 km. per second.

The prevailing high velocities of planetary nebulæ make difficult the continued acceptance of Sir William Herschel's view that the planetary nebulæ evolve into stars [whose speeds are of average dimensions]. On the contrary, there is some basis for the suggestion that the planetary nebulæ have been formed from the rushing of high-velocity stars through resisting media in space. Rapidly-moving stars are the ones which would have the greatest chance to encounter resisting media, and the collisional or bombardment effects would be the more effective in generating nebular condition the higher the velocities of impact.

Heber D. Curtis: *Preliminary Note on Nebular Proper Motions.*

Knowledge of the distances and linear dimensions of the nebulæ are important in studies as to the nature of the nebulæ themselves, and especially as to their relation to the stellar system. It is desirable, therefore, that every opportunity be utilized to determine the proper motions of the nebulæ.

Professor Keeler's program of nebular photography with the Crossley Reflector of the Lick Observatory was inaugurated in 1898, continued by him into 1900, and in the next few years completed by Professor Perrine. A new series of photographs of the same objects, with the same telescope, was begun last winter and should be completed in the early summer of 1915. About one third of the proposed photographs have been obtained to date, and nearly all of these have been compared, as to the accurate positions of nebular nuclei and other very definite masses of nebular structure, with the photographs of the same objects secured from twelve to sixteen years ago. If any motions of translation or rotation in the

objects re-photographed have occurred in the interval, these changes seem not to be appreciable, or at most, are exceedingly small. The conclusion drawn from this fact is that the nebulæ concerned are very remote, and therefore are enormous in linear dimensions. These provisional conclusions apply to many of the large irregular nebulæ, such as the Orion and Trifid nebulæ, and to many of the more prominent spirals, including the great spiral in Andromeda.

EWDIN B. FROST: *An Interesting Stellar System.*

Observations have been continued on the spectroscopic binary β Cephei, which has the remarkably short period of 4^h34^m. Some features of the system are discussed, and reference is made to the detection at Berlin of variations in the star's brightness by the photo-electric method.

GEORGE E. HALE: *The Direction of Rotation of Solar Storms.*

It is well known that cyclones and tornadoes in the earth's atmosphere rotate in the right-handed (clockwise) direction in the southern hemisphere and in the left-handed direction in the northern hemisphere. What is the case for solar storms?

The existence of a magnetic field in sun-spots, supported by other spectroscopic evidence, proves that sun-spots are electric tornadoes of immense size. The direction of rotation of the spot-vortex is given by a simple spectroscopic observation.

The results were at first confusing, as spots rotating in both directions were found in the same hemisphere. But it soon appeared that sun-spots usually occur in pairs, lying close together on a nearly east and west line, and always having opposite directions of rotation. Tabulating the polarities separately for the eastern (following) and western (preceding) members of bipolar pairs, we find (with very few exceptions) that the directions of rotation for preceding or for following spots are opposite in the northern and southern hemispheres.

Prior to the recent sun-spot minimum the preceding spots of the old cycle rotated left-handedly in the northern and right-handedly in the southern hemisphere, as in the case of terrestrial storms. Since the minimum the direction of rotation has been reversed. But the spots of the old cycle were all in low latitudes, while those of the new cycle are all in high latitudes. Thus there probably exist in each hemisphere a high latitude zone, in which preceding spots rotate right-handedly in the northern and left-handedly in the southern hemisphere, and a low latitude zone, where preceding spots rotate left-handedly in the northern and right-handedly in the southern hemisphere.

J. C. KAPTEYN AND W. S. ADAMS: *On the Relations between the Proper Motions and the Radial Velocities of the Stars of the Spectral Types F, G, K and M.*

(1) The radial velocities furnish a very thorough test of the theory of the star streams. The results found for the F, G, K and M stars are in close agreement with those we should expect from the theory as derived from proper motions. (2) The radial velocities of the stars of the smallest proper motions show the effects of the two star-streams with the same certainty as those of the other stars. The existence of the two star-streams is, therefore, proven at the greatest distances for which we have adequate data. (3) The K stars behave in general like the other stars, but there are a few exceptional cases. These do not appear to be due to the absence of the second stream. (4) For all of the spectral classes the average radial velocities show a regular increase with the proper motion. (5) Such a change of radial velocity is a necessary consequence of a velocity distribution (for the peculiar motions) different from that given by Maxwell's law. (6) A first approximation to the velocity distribution has been derived for the K stars. It explains the change of velocity with proper motion in a satisfactory manner. (7) Some positive indications have been found of a change of radial velocity with absolute magnitude, the brighter stars moving more slowly than the fainter stars.

S. B. NICHOLSON: *Discovery of a Ninth Satellite of Jupiter.*

A satellite of Jupiter was discovered by means of photographs made with the Crossley Reflector of the Lick Observatory on July 21 and 22, 1914. These photographs were secured in order to determine positions of the eighth satellite, and the new object was in the same photographic field. The ninth satellite is considerably fainter than the eighth, being estimated at about the nineteenth magnitude. Additional observations of the new satellite have been secured in August and September. The preliminary orbit, computed under Mr. Leuschner's direction, shows that the orbital motion is retrograde, that the first estimate of the period is approximately three years, and that the other elements of the orbit are similar to those of the eighth satellite.

C. T. Knipp: *Experimental Data on the Stability of Positive and Negative Ions.*

In an investigation by Dr. O. H. Smith and the writer of the properties of the retrograde rays from a Wehnelt or hot lime cathode, it was found necessary in order to make their presence known, to accelerate these rays by passage through a strong electrostatic field. The photographic method of J. J. Thomson[1] was employed.

A number of plates show anomalies as to the direction of deflection, *i. e.*, the appearance of *positive* lines with *negative* acceleration, while the same exposure shows but little or no trace of the negative lines. This is contrary to what is expected under the given conditions.

This anomaly, the appearance of positive lines on the photographic plate when the acceleration is such as to allow only negative ions to get through the accelerator into the electric and magnetic deflecting fields beyond, can be satisfactorily explained if it is assumed that the positive ion is more stable than the negative ion. In other words a negative ion loses an electron more easily than does a positive ion.

The paper in detail follows the path of the negatively accelerated ion as it issues from the accelerator and notes the possible changes that evidently take place (upon the supposition stated above) as it moves on through the deflecting fields to the photographic plate. In this way every part of the line on the photograph (*i. e.*, the straight portion as well as the parabolic portion), is satisfactorily accounted for, and hence the conclusion that the positively charged ion is more stable than the negatively charged ion.

A number of photographs showing these lines accompany the paper.

III. *Physics*

A. A. Michelson: *Behavior of Metals and Other Substances Near the Rupture Point.*

R. A. Millikan: *The Coefficient of Slip in Gases and its Relation to the Nature of the Impact between a Molecule of a Gas and the Surface of a Solid or Liquid.*

In 1911 I brought forward a new method[2] for the very accurate evaluation of the coefficient of slip between a gas and the surface of a liquid or solid. This coefficient was shown to be equal to the quantity Al in the equation for the law of fall of a small sphere through a gas.[2] This quantity Al was in turn shown to be proportional to the slope of the line obtained by plotting $e^{\frac{3}{2}}$ against l/pa in the "droplet" method for the determination of e. The values of this slope have now been obtained with different gases and different kinds of droplets. It has hitherto been supposed from the work of Kundt and Warburg that the coefficient in question is in all cases proportional to the mean free path of the gas molecule. This conclusion is now shown to be incorrect; for the above-mentioned slopes are not only found to depend on the nature of the surface against which the gas molecule impinges when this molecule remains the same, but also upon the value of the impinging molecule when the surface is the same. These results show that in general gas molecules are not "diffusely" reflected from liquid and solid surfaces as they have recently been assumed to be by Knudsen and others.[3]

[1] J. J. Thomson, "Rays of Positive Electricity," 1913.

[2] Physical Review, XXXII., p. 382, 1911.

IV. *Chemistry*

C. W. Balke and Geo. W. Sears: *The Atomic Weight of Tantalum.*

In order to determine this constant two ratios were studied, $2TaCl_5 : Ta_2O_5$ and $TaCl_5 : 5Ag$.

In the study of the ratio $2TaCl_5 : Ta_2O_5$, the tantalum chloride was hydrolyzed, using nitric acid, and the resulting tantalum oxide was evaporated to dryness and ignited. In five determinations, however, a constant weight was not obtained even after repeated ignition. A fine white deposit was found in the exit tubes of the reaction flask after each analysis showing that the oxide was being lost. An examination into the cause of this showed that the hydrochloric acid was completely removed by ignition, that the nitric acid was difficultly removed, if at all, and that tantalum oxide was lost either mechanically or by volatilization, all of which indicated that the method was unsatisfactory.

In the study of the ratio $TaCl_5 : 5Ag$, several methods involving the removal of the hydrochloric acid from the tantalum were tried but without success. The only method found satisfactory was to dissolve the tantalum chloride in an approximately 5.5 per cent. hydrofluoric acid solution and to precipitate the resulting hydrochloric acid in the presence of the dissolved tantalum. Platinum vessels were used throughout and the final end point was determined in the nephelometer.

[3] *Annalen de Physik*, Kundsen Papers, 1909–1912.

Three determinations by this method gave 181.30 for the atomic weight. From one to two days were allowed for the equilibrium to become established. A further study of this equilibrium, however, showed that from three to five days were required. A final series of determinations is now in progress.

W. D. HARKINS AND E. C. HUMPHREY: *The Capillary and Electrical Forces at the Interface between Two Liquids.*

A method which gives very accurate determinations of the capillary constant at the interface between two liquids has been devised. The method consists in a measurement of the capillary height under the special conditions which are necessary to secure accuracy. The capillary height method proves inaccurate in all cases where one of the liquids gives an alkaline reaction. For such liquids the drop-weight method may be used. This method has been adopted largely by workers in the field of colloidal chemistry, but without any use of the corrections which have now been determined. Since these corrections frequently amount to as much as 37 per cent. they should not have been neglected.

The latter method has been used to investigate the relation between the change of the surface tension and the change of the electrical potential between two non-miscible liquid phases, in order to see if the relationship is such as would be in accord with one of the theories of muscular motion. This theory is in short that in muscular motion the muscle changes from a neutral to an acid reaction, that this causes a change of electromotive force between two different phases (of the order of one volt), and that this in turn gives rise to such a change of surface tension at the neutral point as was found by von Lerch in Nernst's laboratory. The present work shows that von Lerch's results were in accord with the general theory only because of the inaccuracy of his experimental work.

HERBERT N. MCCOY: *The Solubilities of Radium Compounds as Indicated by the Solubilities of Analogous Compounds of Calcium, Strontium and Barium.*

If it be assumed that radium is the fourth member of the alkali earth group, it is to be expected that the properties of compounds of this element, other than those dependent upon its radioactivity, should be determinable from a knowledge of the properties of corresponding compounds of calcium, strontium and barium. A knowledge of the solubility relations of radium and barium compounds is of great practical importance, since the former must always be separated from large amounts of the latter in the course of the extraction of radium from minerals. A systematic theoretical study of the problem indicated the chemical and physical conditions most favorable for the separation of these elements. The theoretical predictions have been verified by experiment and as a result a new method of separating radium from barium has been found which is many times as efficient as the best hitherto known.

S. W. PARR: *The Development of an Acid Resisting Alloy for a Bomb Calorimeter.*

Coals of the Illinois type when burned in an oxygen bomb generate a mixture of nitric and sulfuric acids, equivalent to approximately 30 c.c. of 1/20 N acid. The correction called for as a result of the heat of formation of these acids approximates 100 calories. If in addition some of the metal of the bomb is dissolved, there is generated an additional increment of heat for which a correction can not readily be applied. Hence the use of platinum or gold as a lining for such bombs.

In April of 1911 the first attempt was made to produce an alloy sufficiently resistant to these acids to permit of its use in the construction of an oxygen bomb. The first successful casting was obtained in December, 1911, but this could not be duplicated until quite recently on account of the difficulty experienced in casting the metal in a dense non-porous form free from flaws.

The alloy is of the nickel chrome type with copper 7 per cent. tungsten and molybdenum from 3 to 5 per cent. The standard of reference for solubility is taken as the amount dissolved by 4 N nitric acid at room temperature per 100 sq. cm. per hour. The average amount dissolved for such unit area and time is 0.09 milligram. The original bomb has had upwards of 1,500 combustions with no indications of corrosion.

A large number of parallel determinations with a platinum-lined bomb show a full equivalent of acid as indicated by the resulting titrations. Test bars show a tensile strength of 50,000 to 60,000 pounds per square inch while a sample of wire gave a tensile strength of 124,000 pounds. Attempts to roll the metal into sheets have not been very successful, only small areas having so far been produced.

JULIUS STIEGLITZ: *Molecular Rearrangements of Triphenylmethyl Derivatives.*

The study of the molecular rearrangements of triphenylmethyl derivatives was planned to shed light on the classical rearrangements of oximes, acyl azides, acyl halogen amides, etc., and to test the author's theory concerning the nature and causes of these rearrangements. The investigation has been developed in four directions: (1) Triphenylmethylhydroxylamines, halogen amines and azides have been shown to give the same products of rearrangement. (2) Derivatives of the unsymmetrical radicles $(C_6H_5)_2(C_6H_4X)C$-, $(C_6H_5)(C_6H_4X)_2C$-, and $(C_6H_5)(C_6H_4X)(C_6H_4Y)C$- yield quantitatively the same ratio of products in the different groups as far as these have been examined. (3) Complete proof of the rearrangement of $(C_6H_5)_3C{\cdot}NCH_3{\cdot}OH$ and of the course of the action has been brought—the first rearangement of the kind ever observed. (4) Rearrangement of the hydrazine $(C_6H_5)_3C{\cdot}NH{\cdot}NH{\cdot}C(C_6H_5)_3$ has been effected—the first instance of a hydrazine rearrangement of this type.

E. W. WASHBURN: *Our Systematic Knowledge of the Properties and Behavior of Solutions of Non-electrolytes.*

A satisfactory theory of solutions must first of all give us an answer to the question: What is the relation connecting the thermodynamic potential (or the fugacity, or the osmotic pressure) of a given molecular species in a solution with the composition of that solution, its pressure and its temperature? When this relation is known for any given class of solutions we are at once in a position to calculate the values of such quantities as freezing points, boiling points, vapor pressures, osmotic pressures, solubilities, equilibrium, constants, etc., for solutions of known composition; or vice versa by directly measuring the above quantities we may compute the molecular composition of our solutions and discover what reactions, if any, have taken place between the various components of the solution.

The purpose of this paper is (1) to outline and describe (*a*) the manner in which, (*b*) the extent to which, and (*c*) the conditions under which the above question is satisfactorily answered by our present systematic knowledge of solutions; (2) to state a number of the laws of solutions as formulated in terms of this theory; and (3) to present some experimental data illustrative of the quantitative agreement between theory and experiment.

V. *Geophysics and Geology*

L. A. BAUER: *Present Status of the General Magnetic Survey of the Globe.*

On April 1, 1914, the Department of Terrestrial Magnetism of the Carnegie Institution of Washington had completed the first decade of its existence. One of the first tasks undertaken was a general magnetic survey of the globe. During the period 1905–1914, 47 land expeditions to 107 different countries and island groups, in all regions of the earth, were sent out. Magnetic observations have been made by these expeditions at 3,000 points, extending from 80° north to 70° south. The total length of the cruises of the two vessels used in the ocean magnetic work, the *Galilee* (1905–1908) and the *Carnegie* (1909–1914), is 161,000 miles. By the end of 1916, the first general magnetic survey of the globe for the region between about 70° north and 70° south, or for about 90 per cent. of the total area, will have been completed. Satisfactory progress has likewise been made in the atmospheric-electric work. Perhaps the most important result of the observations made on the *Galilee* and the *Carnegie* is a confirmation of the somewhat striking phenomenon that, while the conductivity over the ocean is, on the average, at least as great as over land, the radioactive content is much smaller. The values of the potential gradient obtained at sea were of the same order of magnitude as those on land.

T. C. CHAMBERLIN: *The Fundamental Segmentation of the Earth.*

The paper proceeds on the assumptions (1) that the earth-body is and always has been an elastic solid, (2) that it is and always has been crystalline throughout, (3) that the specific gravity of its constituents varies appreciably throughout its mass, (4) that it grew up by accessions which varied in the velocities with which they were added and in the positions at which the additions took place, and (5) in general, that the mode of growth was that postulated by the planetesimal hypothesis. It is further assumed that the nebular knot which constituted the nucleus of the earth-growth inherited (1) a certain unknown measure of rotation from the sun, (2) that successive changes in the rate of rotation arose later from the accessions, and (3) that still other changes arose from the contraction of the mass as it adjusted itself to the stresses incident to its growth and to the progress of internal reorganization.

The segmentation discussed in the paper is assigned to changing rates of rotation, the most powerful agency of deformation to which the earth is subject. The first order of deformation under rotation, the passage from a sphere to an oblate spheroid, is passed hastily as familiar ground, save that an analysis is offered of the mode by which an earth-body of crystalline texture, affected by a concentric structure, arising from accretion, and a radial structure, arising from vulcanism, would respond to the varying stress-demands imposed by changing rates of rotation. This first order of deformation or segmentation proceeds by halves acting reciprocally, its basis being the simplest of divisors, two. The essence of the paper consists in showing that when such bipartite division is extended to the second order of segmentation it develops mechanical inadaptabilities, but that a second order of segmentation on the basis of the next simplest divisor, three, results in working adaptations. This order of segmentation gives rise to six sectors of similar form arranged symmetrically relative to the axis of rotation and alternately respecting the sectors of the opposite hemisphere. The special adaptability of this segmentation to ease the stresses that arise from changes in the rates of rotation is pointed out, as also certain causal relations that exist between these sectors and their essential parts. The surficial expression of these sectors is identified with the great physiographic features of the earth's surface.

VI. *Botany Bacteriology*

CHARLES E. ALLEN: *Development of the Male Germ Cells of Polytrichum.*

At the conclusion of the antheridial divisions, each cell contains a blepharoplast which behaved like a centrosome in the last division. This blepharoplast begins to elongate. At about the same time a large spherical body, the limosphere, appears, variously situated in the cytoplasm; later it comes to lie near one (the anterior) end of the blepharoplast. The blepharoplast is now in contact with the plasma membrane; two long cilia grow out from its anterior portion. The nucleus elongates in the same direction as, and in contact with, the blepharoplast. The limosphere divides into two bodies; the smaller remains in contact with the anterior end of the blepharoplast; the larger lies close to the posterior part of the nucleus. The nucleus becomes a long, coiled, finally homogeneous body, of about one and one half turns. The cytoplasm contains another body of variable size, often lying in a vacuole, which is recognizable from a time a little later than the appearance of the limosphere until nearly the completion of the metamorphosis of the nucleus. During this history the cell becomes first approximately spherical, then lens-shaped. The cytoplasm, aside from the special bodies mentioned, gradually decreases in amount. The body of the mature antherozoid consists of the nucleus, with a short portion of the blepharoplast, bearing the cilia, at its anterior end. The rest of the blepharoplast has become indistinguishable. Adhering to the posterior end of the nucleus, but not a part of the body of the antherozoid, are the remains of the cytoplasm, including the larger derivative of the limosphere.

CHARLES J. CHAMBERLAIN: *A Phylogenetic Study of Cycads.*

The cycads, as the only surviving family of an ancient phylum reaching back into the Paleozoic, are peculiarly favorable for phylogenetic study, and the work of others upon the Paleozoic and Mesozoic predecessors of the modern family adds to the opportunity for comparison. The nine living genera of the Cycadaceæ are confined to tropical and subtropical regions, chiefly Mexico, Cuba, Australia and South Africa, but during the past ten years all the genera and many of the species have been studied in the field, and material has been collected for a somewhat complete study of life histories. The accounts already published have dealt with cycads in the field and also with cytological details of development and have been descriptive rather than theoretical, the natural tendency to discuss the comparative morphology and phylogeny of the phylum being restrained for the present. Cytological features have proved to be more uniform and distinctive than the characteristic habit of the family.

The investigation, as it stands, adds support to the already strong conviction that the Cycadofilicales, Bennettitales and Cycadales constitute a single phylum; when completed it may throw some light upon variation, development and retrogression.

WM. CROCKER AND J. F. GROVES: *Method of Determining the Life Duration of Seeds.*

In most seeds in a dry condition the viability persists from 1 to 150 years, varying with the species. There have been several explanations offered for the loss of viability. Exhaustion of food by respiration, degeneration of digestive and

respiratory enzymes, and the others have proved out of accord with known facts. The hypothesis that loss of viability is due to a slow coagulation of cell proteins of the embryo has been proposed and is being tested out by the writers. The testing of this hypothesis is carried out by getting the life duration at any two high temperatures and using these values in the formula that expresses the relation between time and temperature for the coagulation of proteins to find the life duration at any desired temperature. As an illustration of the results, a variety of wheat with 12.5 per cent. moisture gives a calculated longevity of 9.8 years at 20° C. and 110 years at 0° C. This and other calculated values at 20° C. tallies rather closely with records of longevity in wheat. Also the calculated values at various high temperatures tallies rather closely with the found life duration at those temperatures. Two points of technique deserve special mention, the method of maintaining the constant high temperature and the method of sterilizing the seeds for germination. If the hypothesis and method prove tenable they will be of great economic significance in making possible a quantitative statement of longevity as influenced by the factors of moisture content and temperature.

Edwin O. Jordan: *Variation in Bacteria.*

An attempt is made to distinguish in specific cases between true mutations and the more or less permanent adaptive modifications evoked in bacteria by definite environmental stimuli, and to determine the relative value of each in the formation of so-called bacterial species and varieties. The effect of acclimatization upon bacteria is considered as part of the problem. Specific instances of the extent of variation in a given direction and of the plasticity of a pure line strain are also brought out.

William Trelease: *Phoradendron.*

Outline of a taxonomic revision of this genus of American mistletoes, with indication of a new basis for its primary subdivison. The paper embodies the results of a study of all of the materials in the principal American and European herbaria in the course of which almost all of the species have been photographed from the types. One fourth of the recognized species belong to a section that is found in the United States, Mexico and Central America, but is absent from the West Indies and South America; and three fourths, to a section that extends through South America and the West Indies and through Central America and southern Mexico, but is entirely absent from the United States.

Though apparently well adapted to dissemination by birds, the species are rarely of wide geographic range and in general are confined to areas limited by barriers which are effective for non-parasitic plants.

VII. *Zoology and Paleontology*

C. M. Child: *A Dynamic Conception of the Organic Individual.*

Organic individuation may be either radiate or axiate. An organic radius or axis in its simplest terms is dynamically a gradient in rate of metabolism or of certain fundamental reactions. In this gradient the region of highest rate of reaction is in greater or less degree dominant over other regions because of its higher rate of reaction and therefore influences the dynamic processes in them and determines the orderly course of development and functional relation. This dominance apparently depends primarily rather upon transmitted dynamic changes than upon transported chemical substances and the integrating action of the nervous system is its final expression. Since a decrement occurs in transmission, dominance becomes ineffective beyond a certain variable distance and the size of the individual is therefore physiologically limited. Reproduction results from the following conditions: first, physiological or physical isolation of a part from the influence of the dominant region; second, a greater or less degree of dedifferentiation or loss of its characteristics as a part in consequence of the isolation; third, the presence or establishment in the isolated mass of an axial gradient or gradients; fourth, a new individuation and developmental history in consequence of the presence of the gradient and a dominant region. The axial gradients are not fundamental properties of protoplasm but result from local differences in the action of factors external to the protoplasm, cell, or cell mass in question. Orderly progressive development and definitely coordinated function are impossible except where such gradients exist or have existed.

Frank R. Lillie: *The Fertilizing Power of Sperm Dilutions.*

On the basis of the usual supposition that a single active spermatozoon may fertilize an egg of its own species, fertilization of eggs in series of sperm suspensions of increasing dilution should run in accord with the following law: To the point in the series in which each egg receives a single spermatozoon all of the eggs should be fertilized;

beyond this point the percentages of eggs fertilized should fall off at first slowly, then rapidly, and then slowly again to a vanishing point.

This condition is not realized, however, in actual experiments *unless* the time interval between preparation of the more dilute sperm suspensions and addition of the eggs is made very short (less than five minutes). Under such optimum conditions the curve of percentages of fertilized eggs begins to fall from 100 per cent. at a dilution of about 1/3000 of 1 per cent. sperm; the curve falls slowly to about 1/24000 per cent., then rapidly to about 1/300,000 per cent., then slowly again to about 1/90,000,000 per cent. where however about 1 per cent. of fertilizations may still take place. The observations show that beyond a dilution of 1/20,000 of 1 per cent. only a single spermatozoon can possibly be concerned in the fertilization of each egg.

If the time interval be lengthened to twenty minutes, fertilizing power of sperm suspensions may be completely lost at 1/1000 per cent., a point in the series of dilutions at which each egg recieves several spermatozoons. Comparing sperm suspensions of increasing dilution it is found that the rate of loss of fertilizing power is inversely proportional to concentration. Thus the time required for complete loss in a series of sperm suspensions between 1/600 per cent. and 1/120,000 per cent. forms a curve ranging from 45 down to 6 minutes. Presumably the time is even shorter at greater dilutions.

Spermatozoa may be perfectly motile after loss of fertilizing power. Their ineffectiveness in these experiments is therefore due to loss of a necessary substance. This is an interesting confirmation of the postulate, for which all experimental proof has hitherto been lacking, that the fertilizing power of spermatozoa is due to a definite substance. The spermatic substance in question represents the "sperm-receptors" of my theory of fertilization.

W. L. TOWER: *Experimental Production of a New Character.*

The antennæ of the Chrysomelidæ are highly invariable organs and are used but little in taxonomic differentiation, even of the genera and families. Of especial interest, therefore is the experimental production, by means of continued environmental pressure of a factorial group that is productive of antennal conditions not known to exist in any living or fossil Chrysomelidæ. In origin it arose progressively, in one direction, exists in three states of stability, each of which is capable of transference to other species through crossing, thus giving a picture of what may be one method of the production of nearly related genera. A final point of significance is that its behavior in crosses is no criterion of its method of origination, as it arose progressively, with all possible intergrades, but was at all points in the series alternative and dominant to the normal.

S. W. WILLISTON: *The American Land Vertebrate Fauna and its Relations.*

The land vertebrate fauna of Lower Permian or Permocarboniferous age in North America comprises, so far as now known, at least sixty definitely distinct genera, distributed about equally among the Amphibia, *Cotylosauria* and so-called *Pheromorpha*. From all other parts of the world, of approximately equivalent age, less than a dozen genera are known, for the most part imperfectly. In North America vertebrates are known only from New Mexico, Texas and Oklahoma, Illinois, and Pennsylvania. The fauna of New Mexico comprises, so far as is yet known, sixteen valid genera, twelve of them unknown elsewhere, the remaining four somewhat doubtfully identified with Texas forms. Not a single genus or family even of the American fauna is definitely known to occur elsewhere.

The American forms, and especially the higher reptiles, within the limits of their more generalized characters, are very diverse. That localities so little remote as Texas and New Mexico, though showing intimate family resemblances, should be so distinct in their genera is evidence that the world's fauna in Lower Permian times was an exceedingly abundant one. Probably at no time in the earth's history has there been a more extensive fauna of reptiles. As it is, there is no formation known in geological history of approximately equal duration that has yielded a greater number of genera of reptiles and amphibians than the American deposits.

The conclusion is legitimate that as early as the close of Carboniferous times the reptilian fauna of the world was a relatively old one. It has been urged that the relationships of this reptilian fauna with that of the Middle and Upper Permian of Africa was a close genetic one. From a recent study of most of the known specimens of European Permian vertebrates I am convinced that their resemblances are yet closer. On the other hand it has been urged that the American Permian fauna is an isolated one, with-

out any real genetic relationships with any known subsequent fauna; that such resemblances as have been shown are merely primitive or archaic, due to heredity from common ancestors. The truth probably lies between the two views.

VIII. *Physiology*

A. J. Carlson: *Some New Observations on the Physiology of the Stomach in Man.*

A. The relation of the stomach to the sensation of hunger. (1) Peripheral, and central control of the hunger mechanism. (2) Chemical control of the hunger mechanism. (3) The change in the hunger mechanism with age.

B. The relation of the stomach to appetite. (1) The qualitative difference between hunger and appetite.

C. The secretion of gastric juice in man. (1) The chemistry of normal human gastric juice. (2) Factors influencing the rate and quantity of the secretion. (3) The action of tonics or bitters on (*a*) the hunger mechanism; (*b*) on the secretion of gastric juice.

Shiro Tashiro: *On the Nature of Nerve Impulse.*

Lack of fatigue, as measured by ordinary methods, and absence of heat production during continued stimulation in the nerve, have driven some physiologists to consider that the nerve impulse passes through the fiber without consuming any material. With new apparatus which measures as little CO_2 as 0.0000001 gm., we have demonstrated that a living nerve gives off a definite amount of CO_2 and that when it is stimulated, this CO_2 production is increased. These new facts may be interpreted in two different ways. Some believe that a living nerve should be metabolically active like any other tissue, but that the chemical change is not identical with the nerve impulse, but is the result of functional activity. Others consider that the progress of chemical change itself constitutes the nerve impulse. This latter view is supported by some recent results, which show that CO_2 production from the resting nerve under different conditions is parallel to the physiological state of the nerve; that the normal nerve impulse passes toward a point of lower CO_2 production; that the rate of nerve impulse is closely connected with the rate of CO_2 production and that factors which influence the rate of nerve impulse equally influence the metabolism of the resting nerve. The nerve impulse is probably a propagated chemical change, the propagation being due to restoring the equilibrium which was disturbed first at the point of stimulus.

THE PHILADELPHIA MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The sixty-sixth meeting of the American Association for the Advancement of Science and of the affiliated scientific societies will be held in Philadelphia beginning on December 28. We hope to publish next week full details of the preliminary program. It may now be noted that while the council of the association and some of its sections and affiliated societies will meet on Monday morning, the first general session will be held in the University gymnasium on Monday evening. The retiring president, Dr. Edmund B. Wilson, of Columbia University, will introduce the president of the meeting Dr. Charles W. Eliot, of Harvard University, and will give the annual address entitled "Some Aspects of Progress in Modern Zoology." After the meeting there will be a reception in the University Museum by Provost and Mrs. Smith.

The meetings of the sections and of most of the affiliated societies will be in the buildings of the laboratories of the University of Pennsylvania. Luncheon will be served daily in the gymnasium and all those in attendance are cordially invited to be present. The Houston Club is the headquarters at the University of Pennsylvania, and the Hotel Adelphia is the hotel headquarters.

An interesting event of the meeting will be the first session of the newly established section of agriculture, which will meet on December 30. The program will be a modest one, as becomes a new section, and will be specialized to cover some of the questions surrounding the business side of agriculture and the life of people living under it, rather than the strictly production phases. The address of the vice-president of the section, Dr. L. H. Bailey, late director of the College of Agriculture at Cornell University, will deal with "The Place of Research and of Publicity in the Forthcoming Country Life Development." The other main feature of the program will be a symposium on the general subject of "The Field of Rural Economics." Special phases of the subject will be presented by speakers invited to discuss

them, and there will be opportunity for somewhat general consideration. The importance of the economic aspects of agriculture and of rural affairs, and the broad field which the subject opens up, suggest this as an appropriate topic for the new section, and it is hoped that it will prove of general interest.

SCIENTIFIC NOTES AND NEWS

CHARLES SEDGWICK MINOT, James Stillman professor of comparative anatomy in the Harvard Medical School, eminent for his contributions to embryology and biology and for public service in science, died at his country home near Boston on November 19, at the age of sixty-two years.

THE gold medal of the Hayden Memorial Geological Award was presented to Dr. Henry Fairfield Osborn, in recognition of his paleontological studies, at a special meeting of the Academy of Natural Sciences of Philadelphia, on November 24. The presentation address was made by the president of the academy, Dr. Samuel G. Dixon.

ONE of the royal gold medals of the Royal Society, has been awarded to Professor Ernest William Brown, Sc.D., F.R.S., of Yale University, in recognition of his investigations in mathematical astronomy.

THE honorary degree of doctor of science was conferred on November 19 by Brown University upon Professor William H. Bragg, of the University of Leeds, before the corporation and faculty of the university in special convocation. Following the conferring of the degree Professor Bragg delivered the last of four lectures on "X-rays and Crystals," which he has been giving as the first of the anniversary lectures to celebrate the one hundred and fiftieth anniversary of Brown University.

THE John Fritz Medal will this year be awarded to Mr. John Edson Sweet, of Syracuse. Mr. Sweet was one of the founders of the American Society of Mechanical Engineers and one of its early presidents.

AT its last meeting the Rumford committee of the American Academy of Arts and Sciences made the following appropriations in aid of researches on light and heat: to Professor P. W. Bridgman, of Harvard University, $150 in addition to prior grants in aid of his researches on thermal effects at high pressures; to Professor Frederick A. Saunders, of Vassar College, $100 in aid of his research on the spectra of metallic vapors; to Professor Frederick Palmer, Jr., of Haverford College, in aid of his research on the properties of light of extremely short wave-lengths, $200; to Professor Henry Crew, of Northwestern University, in aid of his research on the specific heat of liquids, $200.

THE annual public address of the Philadelphia meeting of the Entomological Society of America will be given on Wednesday evening, December 30, in the rooms of the Academy of Natural Science, by Professor Stephen Alfred Forbes, of the University of Illinois and State Entomologist. His subject will be "The Ecological Foundations of Applied Entomology." At the same meeting Dr. Henry Skinner at the request of the executive committee of the society will present "A History of the Entomological Society of America."

THE anniversary meeting and reception of the New York Academy of Medicine took place on November 19. The anniversary discourse, entitled "Some of the Relations of the Profession of Medicine to Municipal Government" was delivered by the Hon. George McAneny, president of the board of aldermen of New York City.

M. BOUTROUX, professor in the University of Paris, has accepted an invitation of the British Academy to deliver the first of the recently endowed annual philosophical lectures. His subject will be "Certitude et Verité," and the lecture will probably be delivered early in December.

WORD has been received from Dr. W. C. Farabee, leader of the University of Pennsylvania's South American expedition, that he had just returned from a second successful trip up the Amazon. The party traveled some four thousand miles and returned with many valuable collections.

Dr. John L. Heffron, dean of the College of Medicine of Syracuse University, has been appointed a member of the advisory medical council of the state university for a term of five years.

Karl F. Kellerman has been recently promoted from the position of physiologist in charge of soil bacteriology investigations to be physiologist and assistant chief of the Bureau of Plant Industry, U. S. Department of Agriculture.

Dr. F. B. Powers is about to retire from the directorship of the Wellcome Chemical Research Laboratories, London, on December 1, in order to return to the United States. His period of service dates from the foundation of these laboratories by Mr. H. S. Wellcome in 1896. Dr. Power will be succeeded by Dr. F. L. Pyman. The character and policy of the Wellcome Chemical Research Laboratories will continue as in the past.

We learn from *Nature* that by the will of W. Erasmus Darwin, eldest son of Charles Darwin, the Royal Society of London is bequeathed the sum of £1,650; his nephew, Mr. C. Galton Darwin, receives the portraits of Charles Darwin by Lawrence and Ouless, as well as Darwin's medals, Royal Society's candlesticks, snuff-box, christening mug, autobiography, notebook on children, two early sketches of "The Origin of Species," two volumes of "Hooker's Correspondence," the family Bible, the old Dutch brass-bound box containing the family papers, the letters written home from the *Beagle,* and pictures and miniatures. The desire is expressed that these relics should always be kept in the family.

Professor Herman J. Klein, director of the Astronomical and Meteorological Observatory of Cologne, editor of *Sirius,* has died at the age of seventy-two years.

Mr. C. F. Adams, head of the department of physics of the Detroit Central High School, died on October 29, in his sixtieth year.

The American Physical Society holds a meeting in Chicago on November 27 and 28.

The fourteenth annual meeting of the American Philosophical Association will be held at Chicago, Ill., on December 28, 29 and 30, in acceptance of the invitation of the philosophical department of the University of Chicago. The Western Philosophical Association will meet in Chicago at the same time, and all sessions will be participated in by both associations. The Political Science Association also convenes at Chicago, and on December 29, in the afternoon, this association will join the two philosophical associations in a discussion of the subject of Democracy and Responsibility. In addition to this joint discussion there will be a discussion by the two philosophical associations of the subject selected by the executive committee of the American Philosophical Association as the main topic at this meeting. This subject is "The Interpretation of Justice, with Special Reference to Problems forced to the Front by Present Economic, Social and Political Conditions."

It is announced that the award of the Nobel prizes for medicine, literature, chemistry and physics will be postponed till next year. It is proposed in future, as we have already noted, to make the formal distribution of the prizes every year in June instead of December 10, the anniversary of M. Nobel's death, when the awards will merely be announced.

Applications for the Sarah Berliner fellowship for women of the value of one thousand dollars, available for study and research in physics, chemistry and biology, should be in the hands of the chairman of the committee, Mrs. Christine Ladd-Franklin, 527 Cathedral Parkway, New York, by January 1.

Last summer the government of New Zealand took advantage of the meeting of the British Association for the Advancement of Science in Australia to invite a number of guests, including fifteen Americans and Canadians, whose names were given in Science at the time, to join in supplementary meetings in New Zealand. The plan was to hold a two-days' session in Wellington and in Christ Church. The war interfered with the carrying out of the program which had been planned by the New Zealand committee. When

the American visitors sailed from America on July 22, no intimation of the coming war had reached them. They arrived in New Zealand on August 13, in the early stages of the war, but the plans were not wholly abandoned. The committee in charge of the New Zealand meetings decided that they would like to have the American visitors lecture, each of them giving at least one lecture. Most of the American visitors have now returned to their homes.

News of the Routledge expedition to Easter Island is given in the *Geographical Journal.* Mr. Routledge writes little as to the scientific work so far accomplished, merely observing that the remarkable antiquities of the island were being examined by the party. He gives some account of disturbances in the island, due to unrest among the native Kanakas, about 250 in number. The main or only industry of the island—cattle rearing—is carried on by a company under the direction of an English manager, the only permanent white resident. Thefts of cattle and other property of the company had already been rife, when the natives put in a claim to the possession of all the cattle on the island—some 15,000 head—and began to destroy them wholesale. Such was the state of affairs, when the Chilean warship which visits the island every two or three years put in an opportune appearance, and for the moment relieved the situation. Four of the ringleaders were deported, but Mr. Routledge is inclined to anticipate further trouble. He describes the natives as unenterprising, and loath to work even for their own living.

THE United States Bureau of Mines has begun the collection of a general library of petroleum literature under the direction of W. A. Williams, chief petroleum technologist. The details of this work have been assigned to Dr. David T. Day, who has recently been transferred from the United States Geological Survey as petroleum technologist, and who will also assist in a thoroughly organized research into the chemistry of oils, which is being developed by the Bureau of Mines. It is hoped all technologists will aid in the work by exchanging with the bureau all available books and maps on this subject.

A MEETING was held on November 4, at the offices of the British Medical Association, to consider the position of the Belgian medical men and pharmacists, whose professional position has been involved in the utter ruin which has fallen upon their country and has destroyed the whole machinery of the medical profession and its adjuncts. The meeting was convened by the editors of the *Lancet* and the *British Medical Journal,* from which latter journal we take this reproduction, in response to representations made by a provisional Belgian committee, whose representative, Professor C. Jacobs, is now in London. Sir Rickman Godlee took the chair, and after a brief explanation of the position by Professor Jacobs, the following committee was appointed, with power to add to their number, to make an early report on the procedure to be adopted: Sir Thomas Barlow, president of the Royal College of Physicians of London; Sir Watson Cheyne, president, and Sir Frederic Eve, vice-president, of the Royal College of Surgeons of England; Dr. Meredith Townsend, master of the Apothecaries' Company; Sir Rickman Godlee; Dr. Frederick Taylor, president of the Royal Society of Medicine; Mr. T. Jenner Verrall, chairman of representative meetings of the British Medical Association; Dr. Des Vœux; Mr. E. T. Neathercoat, vice-president, and Mr. Woolcock, secretary, of the Pharmaceutical Society. Dr. Sprigge was appointed secretary and Dr. H. A. Des Vœux, treasurer. The instructions of the meeting to the committee were (1) to communicate with the Belgian Minister and the authorities of the Belgian Relief Fund; (2) to apply to America and other countries if desirable for assistance in the raising of any fund, and (3) to report generally.

UNIVERSITY AND EDUCATIONAL NEWS

THE General Education Board has granted $250,000 to Goucher College, Baltimore, conditionally upon $750,000 being raised by April 1, 1917.

A FUND of $60,000 has been turned over to Amherst College by the alumni council. The disposal of the income from this sum is to be

determined by action of the trustees and the council.

The corporation of Yale University has approved a plan for inviting full professors of the university to meet with the corporation at luncheon from time to time during the academic year.

Plans for the celebration next June of the semi-centennial anniversary of the founding of the Worcester Polytechnic Institute are rapidly taking definite shape. A program drawn up by a sub-committee consisting of Mr. Rockwood, Mr. Baker and Professor Coombs has been adopted, and the committee of three has been constituted an executive committee to carry it through. The exercises will begin on Sunday, June 6, and close on Thursday, June 10.

A certain number of Belgian professors and a growing number of students from Louvain, Liége, Ghent and Brussels are now in Cambridge, and although it has proved impossible for the Louvain University to transfer its corporate and official existence to Cambridge, unofficial courses have been instituted, combining, as far as possible, systematic instruction on the lines of the Belgian universities with the individual requirements of refugee students. It is typical of the disastrous conditions in Europe that in view of the appeal issued by the Belgian government for volunteers, it has been decided, in consultation with the Belgian government, that only such students as are physically unfit for military service or have been rejected for other reasons by the Belgian authorities, and are in possession of a certificate to that effect, can be accepted by the hospitality and academic committees.

R. T. Burdick has been promoted to an assistant professorship of agronomy at the University of Vermont and the State Agricultural College at Burlington.

In the chemistry department of Wesleyan Universtiy: Dr. M. L. Crossley, professor of organic chemistry at William Jewell College until 1913 and lecturer in Wesleyan University, 1913–14, has been appointed associate professor and acting head of the department. Dr. H. Lee Ward has been appointed associate professor in the department.

James Murray, B.S.A., manager of the farm of the Canadian Wheat Lands, Limited, at Suffield, Alberta, has been appointed to the chair of cereal husbandry in Macdonald College, McGill University, in succession to Professor L. S. Klinck, who resigned on August 1, to accept the deanship of the College of Agriculture of the University of British Columbia. Mr. Murray was formerly (1906–1911) superintendent of the Dominion Experimental Farm at Brandon, Manitoba.

DISCUSSION AND CORRESPONDENCE

CAHOKIA MOUND

In this journal, August 28, 1914, Mr. A. R. Crook presented a brief note on the origin of Cahokia Mound. The communication is here quoted in full:

> A study of the materials composing the so-called Monks or Cahokia Mound, in Madison County, Ill., establishes, beyond doubt, that it is not of artificial origin, as has been so generally held, but that it is a remnant remaining after the erosion of the alluvial deposits, which at one time filled the valley of the Mississippi, in the locality known as the "Great American Bottoms."

For the benefit of those who may not be familiar with the subject, and for this reason may be misled, we desire to say the statement made by Mr. Crook is erroneous and without the slightest degree of reason, and his conclusion would apply equally well to the pyramids of Gizeh or the ruins of the valley of Mexico.

Cahokia, by reason of its magnitude and importance, has led many to discuss its probable origin. Three theories have been advanced: (1) It is the belief of some that Cahokia is a natural formation. (2) Others regard the lower part natural and the upper part artificial. (3) Some, acknowledging it to be the work of man, believe it to have been erected at a period when the Mississippi flowed between it and the line of bluffs to the eastward, thus placing the mound on the right bank of the stream. However, no one of the

various hypotheses is compatible with existing facts and conditions, and there is no just or plausible reason why Cahokia should be considered other than the work of man, erected after the Mississippi had reached its present channel. True at some time in the past the waters of the Mississippi reached the foot of the bluffs now forming the eastern boundary of the wide lowland upon which the mounds stand. The waters gradually wore away the western bank of the stream until masses of limestone, now forming the cliffs on the Missouri side, were reached. Here a new and permanent channel was formed, and so it has remained until the present time. The entire area between the eastern line of bluffs and the limestone on the west was scoured by the advancing waters, and no single mass of the loose formation could have withstood the elements and thus remained an isolated mound near the center of the plain. The lowland was formed by the gradual shifting of the channel from the east to the west; this movement continued until it was arrested by the resistant limestone. Cahokia stands upon the lowland about midway between the two lines of bluffs. This area was reduced to its present level by erosion, during the time the stream was moving from the east and seeking its present bed. Therefore it would have been a physical impossibility for the mounds, standing at the present time, to have been erected at a time when the waters of the Mississippi flowed along the foot of the bluffs to the eastward.

Some five years ago Mr. N. M. Fenneman in "Physiography of the St. Louis Area," Bulletin 12, Illinois State Geological Survey, wrote (p. 63):

> The partly artificial character of Monks' Mound is evident from its form. That it is in part a natural feature is seen by its structure. Sand is found neatly inter-stratified with loam at an altitude of about 455 feet, or 35 feet above its base. To this height, at least, the mound is natural and as there is sufficient other evidence that the valley was filled in the Wisconsin epoch to at least that height, the original mound may be regarded as a remnant of the alluvial formation of that time. Its base was probably narrowed artificially by the removal of material which was carried to the top. In this way also the conspicuous abruptness of its slopes was probably produced. No natural stratification has yet been found more than 35 feet above its base and therefore, for aught that is now known, more than half its height may be artificial.

The discovery of a mass of sand in the body of the mound does not prove the lower part of the structure to be of natural origin. The sand is mentioned as being "neatly interstratified with loam," but no statement appears as to the extent of the stratum. Was it found exposed on all sides of the work or only at one point? Probably the latter.

Of the great number of artificial mounds which have been examined few, if any, have been a homogeneous mass. Distinct strata of sand, clay, charcoal and ashes, vegetal mold or other materials, occur in the mounds. In some small deposits of clay, of sand and of black soil are in close contact, each mass being the quantity that could have been easily carried by one person. During the construction of the mounds many persons were necessarily engaged. The earth or sand was carried in bags or baskets from the chosen area and gradually the mass accumulated and the mound was formed. If a natural deposit of sand was encountered by the builders on one side of the work, while loam was being carried from another point, the result would be a pocket of sand in the artificial work. This may explain the occurrence of sand "neatly inter-stratified with loam," as mentioned by Mr. Fenneman. This question will be more clearly understood by referring to the writings of Mr. C. B. Moore, in which he describes the structure of many mounds excavated by him throughout the southern states, and likewise to the Twelfth Annual Report of the Bureau of Ethnology.

One illustration in Mr. Fenneman's work deserves mention, Fig. B, Pl. 6. This shows three mounds directly south of Cahokia and bears the legend:

> Group of Mounds one half mile south of Monks' Mound. The low grassy knoll at the left is believed to be entirely natural. It suggests the original forms of the larger mounds which have been artificially shaped.

This conclusion proves the fallacy of Mr. Fenneman's argument, for although the two large mounds represented in the illustration have never been touched by the plow, the surface of the "low grassy knoll at the left" has been cultivated for many years, since early in the last century, and consequently its height has been reduced many feet. A sketch of the group made about the year 1840 and reproduced in "The Valley of the Mississippi," No. 3, September, 1841, shows the mounds to have been at that time of approximately the same height, therefore the "grassy knoll" was at one time thirty feet or more in height, and it is known that during the course of its destruction human remains were revealed by the plough.

Cahokia, the subject of this discussion, is the largest artificial earthwork in the United States. It stands in the extreme southern part of Madison County, Illinois, about six miles east of the Mississippi. It is in form a truncated rectangular pyramid, rising to a height of one hundred feet above the surrounding plain. Its base, rectangular in form, covers an area of about sixteen acres and measures 1,080 feet from north to south and 710 feet from east to west. Surrounding Cahokia are 69 lesser mounds, some of which are more than 40 feet in height. Some are circular, others rectangular; the latter, including Cahokia, are placed with their sides toward the cardinal points. A group of smaller mounds stood near the bank of the Mississippi a little south of west of the main group; between the two were several isolated mounds serving to connect the groups. On the opposite side of the river, on the summit of the ridge a short distance from the river, stood a group of 26 mounds, all of which have long since disappeared. These were within the limits of St. Louis.

As is generally known to those who are familiar with the distribution of mounds in the southern part of the country, there usually occurs in every group one mound which is larger and more imposing than the others. Often the larger work is separated from the main group by an open space, again it is more closely associated with the lesser mounds, sometimes being surrounded by them. The St. Louis group belonged to the former class; the larger group, with Cahokia near its center, belongs to the latter. The mounds of the St. Louis group, and those which formerly stood on the opposite side of the Mississippi, have disappeared, and many of the lesser works of the main Cahokia group have been practically obliterated by the plow. In view of these conditions it is gratifying to know that a movement is now being made to have Congress purchase, and set apart as a park, an area of sufficient size to include Cahokia and certain of the smaller mounds which have escaped destruction. This would preserve the largest earthwork in America, the most imposing aboriginal monument east of the Mississippi. It is quite evident that Mr. A. R. Crook, of Springfield, Ill., is antagonistic to this movement, but such statements as those recently made by him should not be allowed to influence the work now being done.

David I. Bushnell, Jr.
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An Examination of Blood-Ejecting Horned Lizards

The horned lizard's (or horned "toad's") remarkable habit of ejecting blood from its eye when attacked, although well authenticated, is so rarely observed that it is thought by many to have its origin and its creditability in the little animal's dragon-like appearance. Even Ditmars confesses that it took an actual demonstration, witnessed only after handling several hundred specimens, to upset his scepticism. His description of the performance is well known.[1]

Hay (1892), Stejneger (1893), Van Denburg (1897), Brunner (1907), Bryant (1911) and others have observed and mentioned this peculiar habit. It is not limited to any single species.

Various explanations have been suggested; among others that the phenomenon is connected with the breeding season, that it may be due to some parasite, and that it may be "a secondary use acquired by a relatively few forms."

1 "The Reptile Book," p. 145.

Bryant sectioned the eyelids of a blood-ejecting specimen, and found them highly vascular and full of blood sinuses.

On July 4, while collecting specimens of *Phrynosoma cornutum* for examination of stomach contents, I was fortunate enough to witness this phenomenon. One of my students, walking by my side, stooped and thrust out his hand to pick up a large specimen, when he was met by a sudden spurt of blood coming unmistakably from the lizard's eye. The blood spread over the young man's hand in a fan shaped and even smear, extending from the second joint of the index finger to the wrist, and being about thirty mm. wide at the base. On July 7, another specimen, while being chloroformed, shot a quick jet of blood from one eye. The blood was given an almost explosive impulse, and formed a single thick drop on the inner wall of the bell jar. On July 20, another specimen ejected blood while being anesthetized. In this case, the blood on the wall of the bell jar was mixed with tiny fragments of skin and a few scales.

All three animals were subjected to a very careful examination. All were males. Their lengths were 108 mm., 110 mm. and 108 mm. The lizards were in good condition, even being free from tapeworms and other intestinal parasites with which local *Phrynosomas* are much infected. The stomach contents were characteristic, consisting of agricultural ants, small beetles, isopods, etc. In each case, the eye from which the blood was ejected showed a small quantity of clotted blood in the posterior corner. The vessels were slightly swollen. The cornea seemed to be intact. In the first two cases there was a small spot in the sclerotic coat, which can be best described as a blood blister. The contents on removal to a slide, and staining with Wright's stain, showed nothing except a few red corpuscles and lymphocytes. The third specimen showed nothing but a mass of clotted blood in the posterior corner of the eye. In each case, careful dissections were made, using needles and working under a 48 mm. objective. No parasites of any kind were found.

In my opinion, the most significant fact of all is that all three animals were moulting, the third being in quite an advanced stage.

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THE COTTON WORM MOTH AGAIN

THE large northward flight of the cotton worm moth, *Alabama argillacea* Hubn., in September, 1911, is still fresh in the memory of entomologists. In 1912 a few of these moths were taken in Massachusetts, but in 1913 none were found, so far as the knowledge of the writer goes.

The present year none were reported in September, but on the evening of October 17, large numbers appeared at the lights in and around Worcester and were in evidence for several days. No other reports of their appearance in the state this year have been received, but it is hardly probable that they were only locally present.

It is interesting to note that while they were taken during the last week in September in 1911, and from September 21 to 25 in 1912, their first appearance this year was October 17, nearly a month later than in the other years mentioned.

Since the above was put in type this insect has also been reported as abundant in Pittsfield during the same period.

H. T. FERNALD

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SCIENTIFIC BOOKS

Lehrbuch der Meteorologie. Von DR. JULIUS HANN, Professor an der Universität Wien. Dritte, unter Mitwirkung von PROFESSOR DR. SÜRING (Potsdam) umgearbeitete Auflage. Leipzig, 1913, 1914. Chr. Herm. Tauchnitz. 8vo. Pts. 1–9, pp. 800.[1]

It is significant of the progress of meteorology that three editions of von Hann's "Lehrbuch" have been published in the past twelve

[1] Ten parts are to be issued. The last one has been delayed, doubtless on account of the war.—*The reviewer.*

years. The first edition (1901) was at once accorded its rightful place at the head of the list of our meteorological text-books. No other book approached it as a complete, systematic, masterful discussion of the whole range of meteorological phenomena. The well-arranged and carefully selected bibliography alone was worth the cost of the entire volume. In 1906 came the second edition, in which the author introduced certain changes intended to make the "Lehrbuch" somewhat more popular, using that term in the best sense. The number of pages was reduced by 150; some of the less important details were omitted, and considerable reduction was made in the bibliographic notes. In this form the book, embodying all the noteworthy additions to meteorological knowledge which had been made during the years 1901–1906, became a most valued text and reference book to an increased number of readers.

To the great satisfaction of all workers in meteorological science, Professor von Hann has found opportunity, in the midst of his many other activities, and in spite of his advancing years, to revise his "Lehrbuch" once more, this time with the cooperation of Professor Süring. What we noted, in these columns, in regard to the first edition of this remarkable work is true, with added emphasis, of the latest issue. The general plan of the original edition has again been followed, in that the book has been increased in size, and the bibliographic notes, which were much reduced in the 1906 edition, have been restored, extended and brought down to date. For the purposes of the working meteorologist the new edition naturally has a greater value than the second, excellent as the latter was. No one can read over the new "Lehrbuch" without being profoundly impressed by the author's extraordinarily complete grasp of the whole range of meteorological literature. Everything is discussed in the light of the latest information which we have, and everywhere we see the touch of the master-hand, in the clean-cut, well-balanced and thoroughly digested discussions. Thorough as the treatment is, with marked emphasis upon the physical aspects of all the phenomena, the reader who is unfamiliar with mathematical analysis will not find the volume difficult to study. For, following the excellent plan already adopted in the first edition, the more technical mathematical and physical sections are included in an appendix. Special attention has been paid to the latest results of the aerological investigations which have become so important a branch of modern meteorology. The chapters on aerology, on clouds and on atmospheric electricity were prepared by Professor Süring, who is peculiarly competent to deal with these subjects.

Two of the matters concerning which meteorologists, as a whole, are still uncertain are the general circulation of the atmosphere and the theory of cyclones and anticyclones. Probably many readers of the "Lehrbuch" will turn at once to the discussion of these matters, in the hope that they may clear up their own minds on these debated topics. A reading of the sections in which these subjects are considered shows very clearly the gaps in our present knowledge of the facts, and the difficulty of giving satisfactory explanations under these circumstances. The case is stated clearly in the light of our present knowledge, but it is not a closed case.

Meteorologists will find, in the new edition of the "Lehrbuch der Meteorologie," their one absolutely indispensable reference book. Their colleagues, workers in other branches of science, will inevitably refer to this volume for the information which they may need to help them in their own investigations. Thus von Hann's "Lehrbuch" stands as the master-work on the science of the earth's atmosphere.

R. DeC. Ward

Harvard University

Die physikalische Chemie der Proteine. By Dr. T. Brailsford Robertson, professor of physiological chemistry and pharmacology in the University of California. Translated by F. A. Wyncken. Dresden, Verlag von Theodor Steinkopff. 1912. Pp. 447.

This book is a careful compilation of inves-

tigations relating to physical constants and properties of proteins. This line of study, as the author remarks, certainly deserves consideration on the part of chemists and biologists, although it is not yet satisfactorily developed. The book is divided into four parts: (1) chemical statics in protein systems (dealing with preparations of pure proteins and hypotheses concerning protein compounds); (2) electrochemistry of proteins (conductivity, etc); (3) physical properties of protein systems; (4) chemical dynamics in protein systems (hydrolysis of proteins, action of enzymes). Naturally the author's own investigations are discussed at length. In these he tries to apply those quantitative laws which, as a rule, are classified specifically as physicochemical: the gas laws, van't Hoff's theory of dilute solutions and all those other laws which can be derived from them on the basis of thermodynamics. The numerical data of the measurements fit the calculations well in most cases; the conclusion of the author, however, that protein solutions do not contain discrete particles does not seem perfectly justified, since investigations by Einstein and by Perrin have shown that even emulsions allow the application of the gas law in a certain form. Nevertheless the book will certainly prove extremely useful as a manual for all those who are interested in the further development of this important branch of science.

R. BEUTNER

Die Vorzeitlichen Säugetiere. By O. ABEL. Jena, Gustave Fischer, 1914. Pp. v + 309, with 250 figures and 2 tables in the text.

In the introduction the author emphasizes the dominance during the Mesozoic of the great reptiles—dinosaurs on land, mosasaurs in the sea, pterosaurs in the air—which, though mammals, had existed from the Upper Trias to the limit of the Cretaceous, put an effective check upon their evolutionary advancement. The principal abiding place of the mammals has always been the continents, yet by Middle Eocene time one finds the sea mammals, such as the whales and Sirenia, already evolved, and although the aerial realm has never been a domain of the mammals, the bats have for a long time competed with the birds, the heirs of the pterosaurs.

According to Steinmann, the different reptilian stems were not extinguished at the end of the Cretaceous period, but the great dinosaurs are said to have still existed in the great land mammals of the Tertiary, the ichthyosaurs in the dolphins, the mosasaurs in the baleen whales, the plesiosaurs in the sperm whales, the pterodactyls in the bats. This view Abel refutes upon anatomical and other grounds, and derives the mammals from a much more primitive reptilian stock. The author discusses the remarkable preservation of fossil mammals, as seen in the asphalt beds of the Rancho La Brea in California, frozen cadavers in the tundras of Siberia and those preserved in the oil-steeped soil of Galicia and the dry caverns of Patagonia, as well as in the ordinary mineralization of the bones. The principal localities which have produced mammalian remains are recorded; first those of the Mesozoic, then the European localities in their geologic sequence, followed by those of Asia, Africa, North America, South America and Australia in the order named. A very carefully wrought out chronological table is given, correlating the faunas of the five continental regions, the North American column presenting the six successive faunal phases as originally proposed by Osborn.

The oldest mammalian remains are discussed, no Permian ones being known, but the Upper Trias producing forms which seem to point to an origin at the latest by Permian time. The position of the ancient mammals in the "system" of living mammals is next dealt with historically. Abel recognizes the difficulty of erecting a system of classification which shall also give the phylogenetic stages in the history of any stock, and states that it almost seems as if it were impossible, on the basis of our present taxonomy, to form a satisfactory compromise between that and phylogeny. His own classification, though in many cases it does not give full recognition to phylogenetic facts, seeks, where possible, to lay emphasis on the historic and genetic

events in the history of the mammalian stocks.

The bulk of the book is taken up by a summary of the extinct mammals; first those without the placenta (Eplacentata), or the marsupials, including the Allotheria or multituberculates, the African *Tritylodon, Ptilodus* and *Polymastodon* of North America, and the various types described by Ameghino from Patagonia. After these comes a discussion of the diprotodont marsupials in Australia and South America, while the triconodonts are included with the polyprotodont types. Placental mammals embrace the Pantotheria or trituberculates and all forms above them, of which the insect-eating types or Insectivora are the most primitive; the author also includes under this head the unique Tillodonta, *Tillotherium* and its rare allies, whose position in the mammalian scheme is very doubtful. The relationships of the creodonts and fissipede Carnivora are clearly set forth, after which Abel describes the ancient whales.

The group of edentates are discussed under two distinct heads, the Xenarthra or "poor-toothed" mammals of South America, and the Nomarthra, those of the Old World, of which there are relatively very few. Rodents are briefly dismissed, the curious horned types, *Epigaulus* and *Ceratogaulus,* of the Miocene of Colorado and Kansas being emphasized as the most remarkable.

The hoofed mammals are always the most conspicuous and numerous forms in every fossil fauna, and to them the greater part of the volume under consideration is devoted. Twelve orders are recognized, of which the first is the "Stammordnung" Protungulata, embracing all of the forms usually included under the order Condylarthra and certain additional families such as the Pantolambdidæ, here considered as ancestral to the Amblypoda instead of being placed under that order as is the usual custom. The Bunolitopternidæ, ancestral to the Litopterna, are also placed here.

Following the ungulates, the primates are discussed, but a very brief section only is given to fossil man.

The final chapter of the book is upon the rise, dominance and decline of the mammalian stem. Of particular interest is the author's discussion of the causes of extinction, great emphasis being laid upon the possibility of contagious diseases having an extensive influence in the extinction of faunas.

Altogether the book is a well-balanced production which avoids excessive technicalities but gives a very good general idea of the more essential facts of mammalian anatomy, classification and relationships as disclosed by paleontology. It shows, moreover, how necessary for systematic work in recent zoology an adequate knowledge of extinct animals has become. An interesting commentary upon the advancement of paleontological science is afforded by the fact that the great bulk of illustrative material is drawn from American authorities and based upon the fossil resources of the New World.

Richard Swann Lull
Yale University

The Vegetation of the Nebraska Sand Hills

The average traveler regards the prairies and plains as regions of extreme monotony; particularly is this true if his way takes him through a region of sand hills. The total incorrectness of this view is admirably illustrated by the publication of Professor Pool's researches in the Nebraska sand hills.[1] From an earlier and semi-popular presentation by the same author we had learned to know something of the fascination and scientific interest of these dynamic landscapes, and now we have his detailed results.[2]

The Nebraska sand-hill country covers an area of about 18,000 square miles, that is, nearly a fourth of the area of the state. There are similar but smaller areas of sand hills in Kansas, Colorado and the Dakotas. The soil

1 "A Study of the Vegetation of the Sandhills of Nebraska," Raymond J. Pool. *Minn. Bot. Stud.*, III., 4: 189–312, pls. 15, figs. 16, map 1, 1914.

2 "Glimpses of the Great American Desert," Raymond J. Pool. *Pop. Sci. Mon.*, 80: 209–35, figs. 17, 1912.

is composed of dune sand, probably derived from the Loup Fork (Tertiary) beds. These hills seem to have been formed largely at some previous epoch and to have become stabilized and occupied by vegetation. Through the influence of man, mostly on account of prairie fires and overgrazing, many of these ancient dunes have become rejuvenated to the detriment of those responsible for it.

After giving the results of his careful measurements of wind, rainfall, evaporation, temperature and other ecological factors, Professor Pool takes up in detail the vegetation of the region. It is a pleasure to note the author's caution in using the word "formation." He rightly believes in using this term only for large units, referring the "formations" of many authors to associations. The characteristic upland formation is the prairie-grass formation, which is contrasted sharply with the short-grass formation of the plains, the two embracing most of the great climatic grasslands between our eastern forests and the mountains. These two great formations have similar physiognomy, but different component species; the limiting factors are the available water and competition, and not temperature, as supposed by Merriam. The chief association is the bunch-grass association, dominated especially by *Andropogon scoparius;* this is the vegetation that prevailed generally before the advent of the white man, and is regarded as the temporary climax of the region. The vegetation of this association is open, the grasses occurring in tufts or bunches, but it is supposed that ultimately some closed prairie-grass association will prevail. There is evidence of this in the spear grass association (dominated by *Stipa comata* and *Koeleria cristata*), and farther west in the grama-buffalo grass association (dominated by *Bouteloua* and *Bulbilis*).

Doubtless the most interesting features of the sand hills are the blow-outs. These are retrogressive features and are due, as noted above, especially to prairie fires and overgrazing. At first through the death of the plants there are small patches of bare sand. Later the sand is scooped out by the wind, forming conical or crateriform depressions, known as blow-outs. As the sand is scooped out, more sand falls in from the sides, so that the blow-out is increased in circumference, as well as in depth. Extreme cases are recorded where the depth may be as much as 100 feet and the circumference 600 feet. When wind erosion becomes checked, vegetation again gets a foothold, the chief pioneers being *Redfieldia flexuosa, Psoralea lanceolata* and *Calamovilfa longifolia.* After a time these pioneers are followed by the bunch-grass association; after this vegetational changes are much less rapid. One of the chief features of interest in the woodland formations along the streams is the overlap of the deciduous eastern forest and the yellow pine (*Pinus ponderosa scopulorum*) forest of the west. The lowland formations are much like those elsewhere, as to both content and succession, except that a meadow type represents the temporary climax; probably one of the more eastern of the prairie grass associations represents a more ultimate condition.

Professor Pool is to be congratulated on his thorough and sane treatment of his problem. His contribution is solid and satisfying, and is a pleasant contrast to the many ephemeral disquisitions which even yet masquerade too frequently under the name of ecology.

H. C. COWLES

SPECIAL ARTICLES

THE EFFECTS OF SMALL REPEATED INTRAPERITONEAL INJECTIONS OF WITTE'S PEPTONE SOLUTIONS IN GUINEA-PIGS[1]

THE experiments reported in this preliminary paper form a group in a series which has been planned to determine the organic effects of parenteral introduction of certain substances which may be produced within the tissues of an organism, or which may be absorbed from the gastro-intestinal tract. The fact that Longcope[2] has reported that parenteral diges-

[1] From the laboratories of the Cincinnati General Hospital and the department of pathology of the University of Cincinnati.

[2] Longcope, *Jour. Exp. Med.,* 1913 (18), 678.

tion of egg-albumen may (under certain circumstances) produce organic renal and hepatic changes may mean that splitting of the whole protein leads to these changes, that the effects are the results of the irritant action of substances set free during splitting, or that moieties of the protein molecule by making abnormal combinations may act as irritants, or in some other undetermined way embarrass the activities of the cells of the tissues in which they occur.

In two former publications, Newburgh and I[3] reported the results of a series of injections of indol and tyrosin in animals, and stated that we were able to discover little if any change in any of the parenchymatous organs. In the present series use has been made of solutions of albumose as represented by Witte's peptone.

The protocols follow: In them the expression "peptone solutions" means one prepared as follows and then sterilized:

Witte's peptone	1 gram.
Sodium chloride	0.5 "
Distilled water	100.0 c.c.

Guinea-pig 1.—Weight 400 grams. This animal received 17 daily injections each of 1.5 c.c. of the peptone solution, a total of 25.5 c.c., or .255 gram of albumose. It died suddenly on the day following the last injection. The cause of death was not discovered. The post-mortem was done while the animal was still warm, and showed no other changes than a slight mediastinal edema, moderate hyperplasia of the lymph-nodes and congestion of the lungs, liver, spleen and kidneys. Microscopic examination (Lab. No. 1078) of the tissues showed edema and congestion with occasional small hemorrhages in the kidneys, with a few areas of small round cell infiltration; enormous congestion of the adrenals; edema and focal necroses of the thymus; and hyperplastic changes associated with congestion in the lymph glands and spleen. The spleen was more than normally pigmented.

[3] Woolley and Newburgh, *J. A. M. A.*, 1911 (56), 1796; and Newburgh and Woolley, *Cin. Lancet-Clinic*, April 13, 1912.

Guinea-pig 2.—Weight about 350 grams. This animal received 57 daily injections each of 1.5 c.c. of the peptone solution; a total of 85.5 c.c., or .855 gram of albumose. During the period of treatment it gave no sign of any untoward effects of the treatment. It ate well, lost no weight, and was finally chloroformed 72 hours after the last injection. The post-mortem was done while the body was still warm. The organs showed no abnormal macroscopic or microscopic (Lab. No. 1205) lesions, other than a moderate, generalized congestion associated with a very moderate edema of the parenchymatous organs. This, however, was no more than is usual after chloroform anesthesia.

Guinea-pig 3.—Weight about 400 grams. This animal received 30 daily intraperitoneal injections each of 1.5 c.c. of the peptone solution, a total of 5 c.c. or .45 gram of albumose. It was killed with chloroform. The post-mortem showed only a very moderate congestion and edema of the liver, spleen, kidneys and adrenals, and a slight hyperplasia of the mesenteric lymph glands. Microscopic examination (Lab. No. 1179) showed nothing abnormal except perhaps a slight degree of hyperplasia of the mesenteric lymph glands.

Guinea-pig 4.—Weight about 400 grams. This animal received 5 c.c. of the peptone solution each day for 7 days, 35 c.c., or .35 gram of albumose. It was killed with chloroform. At autopsy nothing was found which was abnormal. Microscopic examination (Lab. No. 1243) was equally negative.

Guinea-pig 5.—Weight about 350 grams. This animal was treated in the same manner as No. 4 for a period of 20 days, during which time it received a total of 100 c.c. of the peptone solution, or 1 gram of albumose. It was chloroformed and autopsied. During the period of treatment it lost 87 grams in weight. At autopsy nothing noticeable was found except a partially healed meager exudate on the surface of the spleen. The peritoneal cavity contained 2 c.c. of a clear fluid. Microscopic examination of the tissues (Lab. No. 1276) showed no lesions except in the case of the spleen, in which there was an increased amount

of pigment and a moderate hypertrophy of the Malpighian follicles. The capsule was thickened.

Guinea-pig 12.—Weight 412 grams. This animal received 50 intraperitoneal injections of 5 c.c. of the peptone solution in the course of two months, a total of 250 c.c., or 2.5 grams of albumose. After each injection it was submitted to deep chloro-anesthesia for 15 minutes. After 25 treatments the weight had increased to 455 grams. At the end of the treatments the weight was 485 grams. The post-mortem revealed nothing macroscopically abnormal, and physically the animal seemed to be in the best sort of condition. Histological examination (Lab. No. 1595) showed that there was a certain amount of anatomic modification of the tissues of some of the organs. The report was as follows: The kidney shows a well-marked edema and cloudy swelling. The glomerular spaces are dilated and the tufts compressed, and in the spaces there is considerable coagulated albuminous material. About the glomeruli there are frequent small accumulations of small round cells, and in the outer layers of the cortex there are occasional lines of interstitial fibrosis. The whole organ showed congestion. The liver showed a very well developed edema, to the extent that in many areas the cells show what seems to be hydropic changes. With this is associated congestion and very moderate interstitial fibrosis as exemplified in the occasional collections of small round cells in the perilobular connective tissues. The spleen shows enormous hyperplasia of the Malpighian follicles together with some increased pigmentation. Within the corpuscles there is evidence of cellular fragmentation. The adrenals show a few collections of formative cells in both medulla and cortex, chiefly in the latter. The other organs revealed nothing remarkable.

Guinea-pig 11.—Weight 445 grams. This animal was treated in exactly the same way as No. 12. After 25 treatments it weighed 482 grams and at the end of the experiment, 565 grams. The report of the histologic examination (No. 1609) stated that the changes were similar to those found in No. 12, except that there were a few retention cysts in the kidneys and that there was nothing of note in the adrenals except an intense congestion.[4]

In this series, which is admittedly small, there is evidence (which we are attempting to verify by an extended series of experiments) that albumose introduced parenterally into the guinea-pig has very little, if any, harmful effect unless the oxidative powers of the organism are below normal. In view of the results of Longcope's experiments, as compared with ours, it seems possible that the more complex proteins will produce effects in the absence of decreased oxidation which the less complex ones will not produce under similar circumstances.[5] We are carrying out a series of experiments which we hope will throw some light upon this problem.

PAUL G. WOOLLEY,
DAISY CLARK,
AMIE DEMAR

THE CULTURE OF DIDYMIUM XANTHOPUS (DITMAR) FR.

IN a recent attempt to isolate an ascomycetous fungus occurring abundantly on the seed pods of sweet clover (*Melilotus*) there appeared on one of the plates an organism that had spread over the surface of the synthetic medium. The striking feature was the network of anastomosing branches varying in width and height to about two millimeters. These were brownish yellow, and slightly raised above the surface of the agar, the whole having the appearance of the vascular system of some maple leaves, as seen on the ventral surface. Microscopical examination showed that these ridges were composed of granular protoplasm with no evidence of a containing vessel or cell wall. About ten days after discovery the culture was again examined and

[4] The histologic examinations in these cases were made by Dr. T. H. Kelly, who had no knowledge of the experimental procedures used in the individual cases. They were subsequently verified by one of us (P. G. W.).

[5] These results call to mind Opie's work along somewhat similar lines (*Trans. Assoc. Amer. Phys.*, 1910, XXV., 140).

showed at that time areas of fully developed sporangia which indicated that this organism was a Myxomycete. A culture was submitted to Dr. Thomas H. Macbride, who identified the organism as *Didymium xanthopus* (Ditmar) Fr.

Since the first appearance of this organism cultures have been readily established by transferring small portions of the vegetative form to fresh media, and also by sowing spores. At the present time the third generation from spores is growing luxuriantly and is furnishing excellent material for further study of this very interesting organism. It has been possible to obtain practically all stages in the formation of the sporangium by fixing material taken every two hours during the process of development.

It can also be readily observed with the low power microscope that the protoplasm exhibits reversible streaming movements in somewhat definite channels. This movement occupies but a few seconds in each direction, first accelerating and then retarding to a point of rest before reversing. This feature will have some value to the teacher who wishes to demonstrate protoplasmic streaming to students, for it is superior to any other material observed for this purpose.

A more extensive report of morphological and physiological studies of this organism will be published at a later date.

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The Effect on Plant Growth of Saturating a Soil with Carbon Dioxide

The following note reports a greenhouse experiment with corn and tomato plants where the soil surrounding the roots was gradually saturated with carbon dioxide, the aerial portions of the plants being under normal conditions throughout the experiment. The plants were grown in six-inch earthenware pots in a normal greenhouse soil. Both kinds of plants grew uniformly and there was no choice between the individual corn or tomato plants selected for the experiment.

A bell-jar, about ten liters in capacity and of the same shape as an ordinary aspirator bottle, was placed over one of the tomato plants. The earthenware pot containing the plant was raised up so that as much as possible of the plant was outside the jar. Absorbent cotton was placed about the plant at the mouth of the bell-jar. The bell-jar was put on a glass plate smeared with vaseline. One of the corn plants was treated in exactly the same way. No carbon dioxide was added for a week and the plants growing in the pots, enclosed by the bell-jars, made as good growth as the check plants.

A steady stream of washed carbon dioxide, of such speed that it gave two bubbles of gas per second as it passed through the wash bottle, was led into each of the bell-jars through a side opening near the bottom of the jar. This was continued for two weeks.

The lower parts of the plants were affected first and in a week the ill effects extended entirely over the plants. The leaves drooped, turned brownish, withered and curled up. The veins of both treated plants darkened. The plants were practically brown at the end of two weeks' treatment, the tomato plant being more physiologically affected than the corn plant.

After two weeks the side openings through which the carbon dioxide had been introduced were left open. The tomato plant soon damped off at the mouth of the bell-jar, while the corn plant began to revive, sent out new growth and at the end of a week was growing normally. Two weeks after the treatment was discontinued it had made ten inches of new growth.

From the way the check plants grew, the greenhouse temperature was satisfactory for plant growth and the soil was a normal one. The bell-jars did not produce the results, as they did not inhibit growth before the carbon dioxide was applied or after its application was discontinued. A carbon dioxide saturated soil upset the growth of these plants but did not change the soil so that the plant could not grow after its application was discontinued.

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THE EFFICIENCY OF HALOGENS IN INDUCING METAMORPHOSIS IN FROG LARVÆ[1]

GUDERNATSCH has shown in his interesting and important experiments on the effect of feeding larval frogs upon the substance of certain glands with internal secretions, that thyroid accelerates metamorphosis to a marked degree. Inasmuch as the present writer has been studying the involution of the organs of the tadpole during metamorphosis, Gudernatsch's results were of significance and opened at once the question as to what component of the thyroid exerted this accelerating effect. To the solution of this problem I turned my attention during the past summer, hoping that data would be found to aid in interpreting the observations which have already been made upon the physiological processes involved during metamorphosis.

Attention was first directed to the thyroid constituents. All of the iodin-bearing portions of the gland substance gave positive results, while the nucleoprotein, lipoid and other fractions were negative. The negative results given by feeding lipoid is significant in the light of the theory of von Fürth that cholin is responsible for the vaso-motor effects of thyroid; for the lipoid-free thyroid substance gave positive results, showing that cholin, which is present in thyroid only in the lecithins, is not functional in a vaso-motor capacity in inducing the different changes in the metamorphosing tadpole. Other evidence, such as ligation of the chief blood-vessels of the tail previous to and during involution, which does not affect the rate of tissue absorption, points to the fact that blood changes are not responsible for metamorphosis.

Iodin seems to be associated in the thyroid with a globulin which Oswald has called thyreoglobulin, which, on hydrolysis, is reducible to a mass called iodothyrin by Baumann; this is a mixture of end-products of protein disintegration and especially of amino-acids, some of which, such as tryptophan and tyrosin, probably hold the iodin in some sort of association, but in what way is not known at present. Now in the present set of experiments, thyreoglobulin, iodothyrin and an iodated amino-acid, tyrosin (3, 5, diodo-tyrosin), gave positive results when fed separately to the larvæ. The tyrosin used was from a pancreatic digest and after recrystallization it was iodated at 0° C. with resublimed iodin scales.

Other iodin compounds, not derived from the thyroid, were examined. Starch iodate, marine iodin-bearing algæ, iodated hen's egg lecithin and all of the inorganic iodides tried gave negative results. Iodated Witte Peptone gave positive results, quite comparable in every way with those obtained with thyroid. Inasmuch as only "organic" iodin gave positive results and then only when associated with proteins, the conclusion seems to be warranted that the iodin, in order to be available, must be in some way associated with amino-acids. The iodin of the plant material is known not to be in the same form as in thyroid, for in algæ it is always associated with potassium, probably as KI; therefore the plant iodin is not an exception.

Two theories may be proposed to account for this effect of iodin: (1) If the process of involution is due to phagocytosis as Metchnikoff, Mercier and many others believe, we have a basis for the accelerating action of iodin in the work of Marbé, who has shown that organic iodin preparations raise the opsonic index of blood of mammals. (2) If, as the work of Loss and of the present writer[2] up until the present time seems to show, the process concerns, initially, at least, some factor other than phagocytosis, and that probably it is a matter of autolysis, then we may resort to the results obtained by Kepinow, where iodin accelerates that process. In all probability, the rôle of iodin is two-fold, that is, instigating and accelerating autolysis in the first place, and secondly, favoring phagocytosis. While we do not know certainly what relation exists between the destructive changes, collectively designated involutionary and those concerned with differentiation, results obtained by the

[1] The complete details of this work are published in another journal (*Jour. Biol. Chem.*, Vol. 19, 110–13).

[2] *Proc. Soc. Exp. Biol. and Med.*, Vol. 11, p. 184; *idem.*, Vol. 10, p. 31; *Amer. Jour. Physiol.*, December, 1914.

writer point to the invariable precedence of the former, so that these may set up processes of differentiation. M. Morse

Madison, Wis.,
September 25, 1914

SOCIETIES AND ACADEMIES

BOTANICAL SOCIETY OF WASHINGTON

The ninety-eighth regular meeting of the Botanical Society of Washington was held in the assembly hall of the Cosmos Club at 8 P.M., October 6, 1914. Forty members and two guests were present. The following scientific program was given:

Mr. P. H. Dorsett, "The Botanical Garden of Rio de Janeiro, Brazil" (with lantern).

Mr. W. F. Wight, "Andean Origin of the Cultivated Potato" (with lantern and specimens).

Both papers are to be published elsewhere.

The fourteenth annual meeting of the Botanical Society of Washington was held at 1:30 P.M., October 23, 1914, with twenty-nine members present. The customary reports were presented and approved and the following officers were elected for the ensuing year: Dr. R. H. True, president; Mr. G. N. Collins, vice-president; Professor C. E. Chambliss, recording secretary; Dr. Perley Spaulding, corresponding secretary; Mr. H. C. Gore, treasurer, and Mr. W. E. Safford, vice-president to the Washington Academy of Sciences.

The ninety-ninth regular meeting of the Botanical Society of Washington was held in the assembly hall of the Cosmos Club at 8 P.M., November 3, 1914. Forty-nine members and three guests were present. Mr. Wilson Popenoe was unanimously elected to membership. The scientific program was:

Mr. Paul Popenoe, "The Date Palm in Antiquity" (with lantern).

The speaker referred particularly to the influence of the date palm on the religion of the Semitic peoples. Prized for the food and drink it furnished, it was revered because of the mystery of sex emphasized by its monœciousness, and became identified with the primitive mother goddess of fertility. A sacred palm in a garden at Eridu, near the mouth of the Euphrates River, is thought by many investigators to be the origin of the Tree of Life of the Garden of Eden, described in Genesis. The culture of the palm was thoroughly known at a very early period, the Babylonian inscriptions giving reason to believe that it was more skilful 1900 years B.C. than it is in that region 1900 years A.D.

Mr. W. E. Safford, "The Economic Plants of Ancient Peru."

This paper was based upon collections and observations made by the writer while cruising along the Peruvian and Chilian coast, in 1887, and while acting as commissioner for the World's Columbian Exposition to Peru and Bolivia, in 1891 to 1893. Prehistoric graves were opened at Caldera, Iquique, Arica, the Rimac Valley, Ancon, Chimbote, Truxillo, and the vicinity of Payta. The material obtained is mainly in the Field Columbian Museum at Chicago and the United States National Museum. In addition to objects of ethnological interest many articles were found illustrating the ethnobotany of Ancient Peru. Not only were seeds, seed-pods, dried fruits, leaves and tubers found, but beautiful representations of many of the food plants in terra-cotta, in the form of funeral vases, were discovered in graves near the coast, especially at Chimbote and Truxillo. Among these were a number not included in Wittmack's list published in Reis & Stuebel's great work "Das Todtenfeld von Ancon." Beautiful models in terra-cotta of the tubers of *Solanum tuberosum* were found, also of the fruits of *Solanum muricatum* and *Lucuma obovata*, and most interesting of all the almond-like kernels of *Caryocar amygdaliforme* R. & P., easily distinguished by their protruding recurved embryo. Another interesting object was a terra-cotta vase representing the roots of the achira (*Canna edulis*). The collections include specimens of *Phaseolus vulgaris* and *Phaseolus lunatus*, a gourd full of peanuts (*Arachis hypogœa*) and models of the same on terra-cotta vases; mandioca roots and models of the latter; quantities of maize and models of the same on funeral vases; bags of coca leaves (*Erythroxylum Coca*), and specimens of raw cotton, dark brown, light brown and white, together with spindles with cotton yarn upon them; looms with half-woven fabrics and textiles of beautiful and intricate designs. Among the most interesting of the funeral vases were forms representing the corn god of ancient Peru, a monster with protruding tusks, surrounded by ears of maize; and the god of agriculture, represented with a stalk of maize in one hand and a stalk of mandioca in the other, with a cluster of roots at the base very much like those of a dahlia.

The paper was illustrated by numerous slides, principally of objects in the collection of the Field Columbian Museum.

Perley Spaulding,
Corresponding Secretary